JOURNAL OF CYCLE RESEARCH

Vol. 4 No. 1

January 1955

JOURNAL OF CYCLE RESEARCH

LEONARD W. WING, EDITOR

3875 Vorhies Road
Ann Arbor, Michigan

CONTENTS, JANUARY 1955

The Journal of Cycle Research is published quarterly at 680 WEST END AVENUE, NEW YORK 25, NEW YORK. by

THE FOUNDATION FOR THE STUDY OF CYCLES

Subscription to the Journal of Cycle Research costs $5.00 a year. Single copies are $1.25 each. Send your check to the publication office, Foundation for the Study of Cycles, 680 West End Av. New York 25, New York.

LATITUDINAL SLIPPAGE
OF BOB-WHITE, HAIRY WOODPECKER, AND DOWNY WOODPECKER CYCLES*

BY LEONARD W. WING

RESEARCH ASSOCIATE, FOUNDATION FOR THE STUDY OF CYCLES**

YEAR-TO-YEAR changes in the numbers of animals have generated a great deal of perplexity and confusion. Field biologists studying bird and mammal life perforce have a greater interest in fluctuations, cyclic or otherwise, than almost any other group. Some hold that cycles are real, although not all changes are cyclic. Some hold, it would seem, that almost any change otherwise unexplainable must result from the workings of some mysterious thing called a "cycle." Some non-field biologists hold that there really are no such things as cycles, all fluctuations being random ones. The truth seems to be that there are cyclic changes, noncyclic (and nonrandom) changes, and random changes. I think that every natural time series probably shows all three.

Much of the confusion clearly originates in the many facets of the "cycle problem." It may be likened to the parable of the blind men and the elephant. Each student must of necessity judge from his own observation point—one might say from his own touching of the elephant.

Yet in dealing with the complexity of cycles, one must keep in mind that field biologists studying bird and mammal life recognize the *fact* that cycles exist. With much truth, it has been said that in this group of biologists, there is more "cycle horsepower" than in any other.

One may justly wonder why with such ample *field* evidence for the reality of cycles as a normal phenomenon anyone should relegate all to the dump heap of random happenings. Yet there are probably a number of reasons for this, the chief one perhaps being lack of experience with the phenomenon in the field. One studying cycles wholly on the basis of mathematical concepts quickly loses touch with reality. Hence conclusions so reached may be interesting ones but not necessarily very sound ones.

It might be well if I returned again to the question of what is or is not a cycle. Though the dictionary word *cycle* may mean any movement that returns to its previous state, such a broad use of the word clearly confuses more than it clarifies. With such a meaning, any fluctuation that goes up and down or down and up, in and out or out and in, and back and forth or forth and back would be a cycle. But few if any field biologists would use the term in such a loose way. A cycle as used here and

*PART OF A PAPER PRESENTED AT THE AMERICAN ORNITHOLOGISTS' UNION MEETING, MADISON, WISCONSIN, SEPTEMBER 8-12, 1954.

**THE INSTITUTE OF HUMAN BIOLOGY OF THE UNIVERSITY OF MICHIGAN SUPPLIED LABORATORY SPACE AND OTHER ASSISTANCE.

as used in field studies means a fluctuation that happens again and again at reasonably regular time intervals.

In order to reduce confusion, I have adopted a definition that seems exact and to reflect actual conditions in nature. *A cycle may be defined as a fluctuation having (1) length, (2) rhythm, (3) timing, and (4) amplitude.* Without all four, there is no cycle; the changes are simply noncyclic fluctuations. It must be recognized, however, that at any moment we may not always have the measures for each of these. Because of the confusion and inexactness in use of the word cycle, I sometimes use the term *rhythm*, *wave*, or *ultra-long wave* for rhythmic fluctuations.

Further confusion arises in the selection of turning points used in cycle study. About the crudest form of cycle study is to pick *some* highs or lows in the graphed data as turning points to count in getting an average length. Equally crude is the picking of *all* highs and lows as turning points of cycles. While any and all are turning points of the time series, they may or may not be turning points of a cycle. In fact, they may very likely be turning points of several cycles, random events, or blended events. They may or may not be turning points of cycles; they may or may not be of random origin. They may be real for some cycles and by that token random so far as others are concerned. If one defines turning points of cycles as the high value with lower values on either side or *vice versa*, further progress in cycle study has been practically forbidden by definition. (If this criterion had been applied to temperature for example, we would never have discovered the cycle of the year!)

Cycles of weak amplitude by their very weakness may in a short series give the appearance of random strength and weakness. In fact, with present techniques it may be well-nigh impossible to demonstrate net rhythm in a cycle of weak amplitude. Yet gross rhythm may be clearly present.

One fact, however, does appear in the crude use of all turning points in a time series as turning points of cycles, unwittingly though it may be. If cycles are all harmonics or other mathematical relatives of each other, the manifest cycle created by them will have mathematically related turning points. The fact that they apparently do not* strongly contradicts the concept that all are harmonics or other "descendants" of some master length. It does not test, of course, the possibility that there may be groups of related cycles or families of cycles. It gives no test, moreover, of the reality of cycles in the time series.

Mathematical tests of cycle or rhythm significance are badly needed and no doubt will someday be devised. When they have been devised, the confusion resulting from such lack of mathematical procedures for testing or demonstrating rhythm will be removed. Statistical procedures developed for nonrhythmic situations are not now applicable as tests of rhythm and rhythm significance. Hence, one must still rely upon other procedures.

The inherent roughness of so many field data hampers cycle study. Counts of animals in the field lack a great deal of preciseness; surely this must always be so. Yet even a thermometer or rain gauge is a crude instrument. A physicist in his laboratory may measure temperature to a very close tolerance. No weather instrument is accurate to a fraction of this. Yet one soon realizes that many cycles are far too strong and prominent not to show through a considerable roughness of data.

The greatly complicated nature of cycles requires a large amount of calculation in any analytical work. It took about a quarter of a million handlings of figures, for example, to measure the cycles reported here for the three species mentioned. A previous paper dealing with global pattern of but one cycle in temperature took more. Obviously then, one limitation to measurement of cycles is the laborious computations involved. Hence, it takes a concerted, continuous, and intensive effort.

Cycle Characteristics

In addition to rhythm, timing, length,

---

*Cole, LaMont C., 1951. Population Cycles and Random Oscillations. Journal of Wildlife Management, 15: 233-252.

----------------, 1954. Some Features of Random Population Cycles. Ibid. 18: 2-24.

and amplitude characterizing cycles, a number of additional qualities appear. I shall mention some that bear upon the bird population cycles described in this paper.

A global behavior pattern of the 4.222-year pattern in temperature and tree rings has already been reported.* The present paper now deals with three cycles in three bird species of the United States and Canada. The appearance of pattern on the continental and regional scope parallels that on a World basis. One may justifiably wonder if these continental expressions are not parts of global patterns.

The latitudinal phase charts of state data indicate clearly a 4.222-year rhythm that matches the global rhythm of temperature. Whether cause and effect, of course, we have no way of knowing. But a relationship, direct or indirect, is indicated. The phase chart indicates also that latitudinal slippage or passage of the epochs takes place in the bird populations as in tree rings and temperature. The rate of slippage seems to be the same in all the events reported. Though I do not know yet whether or not the 4.418-year and 3.767-year lengths form global patterns in temperature. I am inclined to think that they do. We would expect therefore that timing, rhythm, and slippage shown in the three birds matches appropriate regional parts of global patterns. Some day we may know for sure.

Cycles so far measured characteristically tend to show greater amplitudes in the higher latitudes than in the lower ones. While the latitude covered by the region here studied is but about 26° and despite crude measurements of bird populations, it appears that this characteristic holds true for birds also.

Source of Data

The lengths used in this study came originally from a study of the flight years of the Pine Grosbeak into the Lake Region and subsequent examination of global pattern in temperature. The flight years proved to result from a reversing cycle of 3.94-years. One member of the pair measured 4.222-years. So far as I know now, this is a single wave length or appears as a single one in a thousand years of tree rings (247 sections). The reversing mate of the 4.222-year cycle measured 3.69-years long. Further study of the 3.69-year length, however, shows that it itself is another reversing cycle. One component proves to be 3.767-years long; I have not measured its reversing mate as yet.

During the course of identifying the 4.222-year length in temperature and other events of the Northland, something about 4.4-years length conflicted with the clarity of the 4.222-year cycle. This other cycle has proved to be 4.418-years long. As long records of tree rings were used in measuring these lengths, it seems best to present the operations involved at another time as part of a separate study of rhythms in tree rings.

The data of bird abundance came from the Bird-Lore and Audubon Magazine Christmas censuses for the years 1900-1939. I converted the original figures to a ratio of birds of each species reported for each hour of censusing. This ratio of birds per hour has been used directly in the periodic tables. No moving average or other manipulation has influenced them. Cycles other than those being tested have not been minimized. As explained in other reports, I often use a modified median (Sometimes called average median or modified mean) for the respective columns of a periodic table. In the nine sections (at most) of the present periodic tables, any random distortions that may be present do not have much opportunity to offset each other. At times (though not in the tables here) I have elected to apply the principle of limited data when many apparent distortions are present. (That is, distortions so far as the cycle being tested is concerned.)

The tree ring data have been obtained from several sources as indicated in an earlier paper (*Journal of Cycle Research,* 3:55-83)

The quality of the data, it should be obvious, leaves much to be desired. The Christmas censuses; however, are the only abundance counts covering both a great area and a long period of years. Though the

---

*Wing, Leonard W., 1954. Global pattern of 4.222-year cycles in temperature. Journal of Cycle Research, 3:55-83.

censuses began in 1900, few regions have regular reports for the earlier years.

Several years ago, I prepared the first forty years of the censuses on the basis of birds per hour of censusing and frequency of occurrence in each state. It is this first forty years that I have used. It would be most important to use the counts since 1939, but they are available only in their untabulated hence unusable, state I see no immediate prospect that this great storehouse of data will be processed for use.

Ordinarily, I do not use a record as short as twenty to forty years in the study of cycles that are as long as three to four years. But in this instance, I have done so because the length of the cycle has been taken from a study of much longer records (up to a thousand years of tree rings). Here the data are used only to test for possible behavior patterns of the respective cycle lengths in bird numbers.

One must therefore employ the accepted scientific axiom that patterned behavior in nature betokens the operation of principles not accidents, of order not disorder, of law not chaos. The phase chart is a graphical device for showing patterns of time and place. This paper is a report on patterns of phase behavior in the Bob-white, Hairy Woodpecker, and Downy Woodpecker.

Bob-white

The Bob-white (*Colinus virginianus*) ranges over eastern North America from southern Ontario southward into Mexico. It has one characteristic that simplifies consideration of population changes; the bird is a resident species, not a migratory one. Hence, the complicating factors of seasonal movements for all practical purposes are eliminated. Few Bob-whites ever die more than a mile or so from their hatching place. The shifting of populations long has been suggested as a factor in population changes. But Bob-white numbers for analytical purposes may be considered like tree rings, crop yields, varves, or other manifestation of a nonmobile nature: whatever influenced them did so at the site. It is not a matter of the birds having moved in from some distant point.

The Christmas census data of the Bob-white were summed for eastern North America by regions as follows (estimated general latitude in parenthesis):

New England (43°N.)
- Maine
- New Hampshire
- Vermont
- Connecticut
- Rhode Island
- Massachusetts

North Atlantic (41°N.)
- New York
- Pennsylvania
- New Jersey
- Maryland
- District of Columbia

South Atlantic (36°N.)
- Virginia
- West Virginia
- Kentucky
- Tennessee
- North Carolina
- South Carolina

Gulf (30°N.)
- Georgia
- Florida
- Alabama
- Mississippi
- Louisiana
- Texas

Lake Region (43°N.)
- Ontario
- Michigan
- Wisconsin
- Ohio
- Indiana
- Illinois
- Minnesota

Northern Plains (46°N.)
- Iowa
- Nebraska
- North Dakota
- South Dakota

The data for most of the states are rather meager at best. The more continuous ones were used later in a state by state phase chart. Hence, not all the thirty-four used in the region groups could be used by themselves.

As I have said before, the shortness of the series does not allow determination from internal evidence whether or not cycles of the respective lengths (3.767-years, 4.222-years, and 4.418-years) are present. But a periodic table for each length for each series will indicate by strength and weakness when highs and lows *would* fall if present. Such show of strength or weakness is subject, of course, to distortions caused by the actions of any other cycles present, to random events, or to any other action upon the series. If the show of strength and weakness marks actual highs and lows of cycles of the respective lengths, however, their timing would be patterned.

Tables 1, 2, and 3 reproduce the periodic tables of the several region groups. They have been graphed in Figures 1, 2, and 3. The high or low of each periodic table has been measured as the midpoint between the appropriate crossing points of the curve made by the plotted means or

modified medians of the tables. As a recent base year of the 4.418-year periodic table projected forward falls at the calendar time of 1951.672, this base year added to the position of a high, as determined in Figure 1, gives the current time of ideal high. Naturally, this time of ideal high is still subject to any unneutralized influences in the table itself.

An example may make the techniques clear. The North Atlantic series gives enough data for nine sections of 4.418-years each. The mean value of the first, second, third, and fourth years after base (Table 1) are 0.37, 0.35, 0.32, and 0.39. The mean of the highest (0.39) and lowest (0.32) amplitudes is 0.355. This then becomes the axis of the curve for the purpose of determining the midpoint of the crossings of the positive phase, which midpoint becomes the time of high. The horizontal arrow of the North Atlantic curve marks this axis; the vertical arrow marks the midpoint at position 4.850. By adding 1951.672 to this position 4.850, the resulting 1956.522 gives a mathematical rendition of the current calendar time of ideal high. Converted to calendar days, it becomes July 10, 1956.

In a like manner, I determined the calendar times of ideal high for the Northern Plains, New England, Lake, South Atlantic, and Gulf regions for the 4.418-year cycle length. Using corresponding periodic tables, I did likewise for the 4.222-year and 3.767-year cycle lengths.

I then constructed a latitudinal phase chart for each of the cycle lengths (Figure 4), plotting the respective times of ideal high against the appropriate average latitudes. The key and current times of ideal high will be found in Table 4. To the chart for the 4.222-year cycle (middle section of Figure 4), I have added as a dashed line the temperature low of the 4.222-year cycle from its global pattern (*Journal of Cycle Research*, 3:72-73, Figure 11). I have added also the epochs of the cycles in tree rings from the previous paper. In this paper the term *epoch* is used to indicate a time of either high or low. The tree rings form a most important corroborator of the birds. Whichever of several different series of tree ring records are used, the epochs of corresponding latitudes fall in time with those of the forty-year or shorter record of the Bobwhite. The 4.222-year cycle has any of 50.66 months in which the epochs could fall. But all the epochs fall in a band less than sixteen months wide, which indicates both gross rhythm and a behavior pattern clearly not of random nature.

The 4.418-year cycle shows a similar behavior pattern with a spread of but thirteen of the possible fifty-three months. That of the 3.767-year cycle is also similar and has a spread of but nineteen of the forty-five possible months. The broken lines have been added to show possible slippage of the cycles, just as in the 4.222-year phase chart. Were longer records available, a narrower spread could be expected. And were it possible to neutralize or to minimize the effects of other cycles, or to eliminate local influences and randoms, the band would presumably approach the theoretical line instead of a band.

The phase charts of Figure 4 show that all three cycles have gross rhythm and pattern of timing, which suggest that the lengths are true cycles present in the Bobwhite population fluctuations. They also suggest that latitudinal slippage is present just as in the tree rings and, for the 4.222-year cycle, as in temperature.

With the knowledge that the regional groupings showed gross rhythm and patterned behavior for each of the cycles, I decided to test further with the data for each state separately. The state data for many states make but two to four sections. Though I would consider nine sections as rather inadequate at best, fewer sections are certainly worse. Nevertheless, they are all that we have available.

Yet despite this fact, the state data do show patterns in timing and gross rhythm. Tables 5, 6, and 7 are periodic tables for the 3.767, 4.222, and 4.418 year lengths, respectively, And Figures 5, 6, and 7 graph the respective averages or modified medians of the several tables. As before, the times of high (upward arrows) or low (downward arrows) are determined from the midpoints between the crossings of the axes (horizontal arrows) by the curves themselves. Adding the mathematical position of the high in the table to the most recent base year gives a representation of the calendar date of the current

time of ideal high. The current times of ideal high I have plotted on separate phase charts (Figures 8, 9, and 10). The key to the designations and times of epoch are given in Table 8.

These three phase charts show a concentration of highs in a band covering thirty-four of the possible forty-five months of the 3.767-year cycle, thirty-two of the possible fifty-one months of the 4.222-year cycle, and forty of the possible fifty-three months of the 4.417-year cycle.

But if we credit six months of the spread to the latitudinal slippage of the 3.767-year cycle, seven months to that of the 4.222-year cycle, and eight months to that of the 4.418-year cycle, the spread is reduced to twenty-eight, twenty-five, and thirty-two months of the possible forty-five, fifty-one, and fifty-three months, respectively.

If we now do likewise and credit the same amount of slippage to the same cycles for the regional Bob-white picture (Figure 4), the spread is reduced to thirteen, nine, and eleven of the possible forty-five, fifty-one, and fifty-three months, respectively. The increased concentration of regional versus state data indicates rather clearly that much of the spread from the theoretical straight line is probably induced by the shortness of record, paucity of data, and influences of local nature.

If we consider the distribution of the *majority* of times of ideal high, we find that they fall in but twelve of the possible forty-five months for the 3.767-year cycle. Similarly the majority fall in but eight of the possible fifty-one months for the 4.222-year cycle and but seventeen of the possible fifty-three months for the 4.418-year cycle. If as before we credit six months, seven months, and eight months for latitudinal slippage of the respective cycles, the spread becomes five of a possible forty-five months for the 3.767-year cycle, one of a possible fifty-one months for the 4.222-year cycle, and nine of a possible fifty-three months for the 4.418-year cycle.

If these highs and lows occur at random, they should be equally distributed over forty-five, fifty-one, and fifty-three months. But that they are not distributed at random but are concentrated in definite parts of the respective forty-five, fifty-one, and fifty-three months is clearly powerful evidence for a rhythmic influence. It seems clear also that this spread would be reduced still further with longer records. On the basis of experience, I would look for a halving or quartering of the spread were century-long records available. Such longer records would give more opportunity for random distortions to balance each other and for other cycles to be minimized. The cycles in question would thus have greater opportunity to show through.

Hairy and Downy Woodpeckers

Next after the Bob-white, I chose the Hairy Woodpecker (*Dendrocopus villosus*) and Downy Woodpecker (*Dendrocopus pubescens*) for a study similar to that of the state by state one for the Bob-white. But because of labor involved, only the 4.222-year cycle has been tested thus far for these two species.

I selected these two species because (1) they inhabit all states and provinces covered by the Christmas censuses, (2) they are migratory in the northern parts of their range or irregularly so, (3) they are easily observed and counted by census-takers (4) they are common enough to give substantial observational information, and (5) they are related closely enough taxonomically and ecologically to serve as comparisons with one another.

The times of ideal high have been determined by periodic tables (Tables 9 and 10), just as for the Bob-white. The means and modified medians have been graphed (Figures 11 and 12). From the times of ideal high, I constructed latitudinal phase charts separately for the Downy Woodpecker and Hairy Woodpecker (Figures 13 and 14). Table 11 gives the key to the symbols used in the phase charts and the times of epochs.

A rather different and more complicated pattern appears in these two species as compared to that of the Bob-white. The same tendency to form bands appears in the phase charts. But the highs of the southern part of the ranges cluster near the slippage line for the ideal time of low of the 4.222-year cycle in temperature as taken

from the 4.222-year temperature latitudinal phase chart (*Journal of Cycle Research,* 3: 72-73, Figure 11).

The band spread for the Downy Woodpecker is about eight months between latitudes 28°N. and 38°N. Four months of this very properly may be charged to latitudinal slippage. As in the Bob-white, if the several highs fall at random, they would have fifty-one months over which to be distributed instead of four months. Northwards from about 44°N., the highs cluster near the line marking the slippage of the ideal time of high for the 4.222-year cycle in temperature. Because of the few areas involved, the spread cannot be determined very well, but it is greater than southward from 38°N.

Between 38°N. and 44°N., the highs cross over from the line of temperature lows to the line of temperature highs. Just how the cross-over takes place, I cannot say. It may be that in this region, the birds show tendency for a doubling of highs. Or it may be that the state or province is too large an area for revealing the workings of this phenomenon. British Columbia and Alberta show some divergence from the pattern set by more interior areas. But the few census reports may account for it.

If one looks at it the other way around, he will note that the highs in the southern part of the range avoid the line of temperature high (if projected); the highs in the northern part similarly avoid the line of temperature lows (if projected).

Rhythm and timing are clearly present, and we may feel confident that the 4.222-year length is a true 4.222-year cycle in these birds, just as in the Bob-white. In addition, we find a difference in response to the same 4.222-year cycle that evidently is of an environmental or regional nature. It shows that birds, even of the same species and though showing the same cycle, do not necessarily show the same epochs everywhere.

The pattern in the latitudinal phase chart of the Hairy Woodpecker is identical to that of the Downy Woodpecker with a few minor variations. The crossing over takes place between about 39°N. and 45°N. instead of 38°N, to 44°N. But this may be only an apparent difference because of paucity of data. The spread of the cluster along the line of the latitudinal slippage tends to be greater. It averages about eighteen months (fourteen net with allowance for slippage itself). Presumably the fewer numbers of Hairy Woodpeckers and consequent less adequate data than for the Downy Woodpecker plays a part in the less well defined pattern of the former species.

Summary.

A cycle is defined as a fluctuation having (1) length, (2) rhythm, (3) timing, and (4) amplitude.

Christmas census data (as birds per hour of censusing, 1900-1939) for the Bob-white, Hairy Woodpecker, and Downy Woodpecker in the United States and Canada were tested for presence of three cycle lengths: 3.767, 4.222, and 4.418 years.

The Bob-white population data evidence presence of the three cycles in (a) regionally summed and (b) in state-summed data. Latitudinal phase charts for each cycle length show that the cycles have latitudinal slippage on a regional scale.

Though the epochs of the three cycles have any of forty-five, fifty-one, or fifty-three months, respectively, in which to fall if of random origin, all concentrate in a restricted part of these possible intervals.

The Hairy and Downy Woodpecker data from the Christmas censuses were tested for presence of the 4.222-year length.

The population highs of this cycle for both species cluster at the temperature low of the 4.222-year cycle in the southern part of the ranges and at the temperature high in the Northern part. A cross-over occurs between about Latitudes 38°-39°N. and 44°-45°N.

Regional or environmental influences may make different responses to the same cycle in the same species.

The latitudinal slippage of the Hairy and Downy Woodpeckers is the same as that found previously for the global pattern of temperature.

It is presumed that the pattern shown in the United States and Canada for the three birds may be regional expressions of appropriate global patterns.

3875 Vorhies Road
Ann Arbor, Michigan

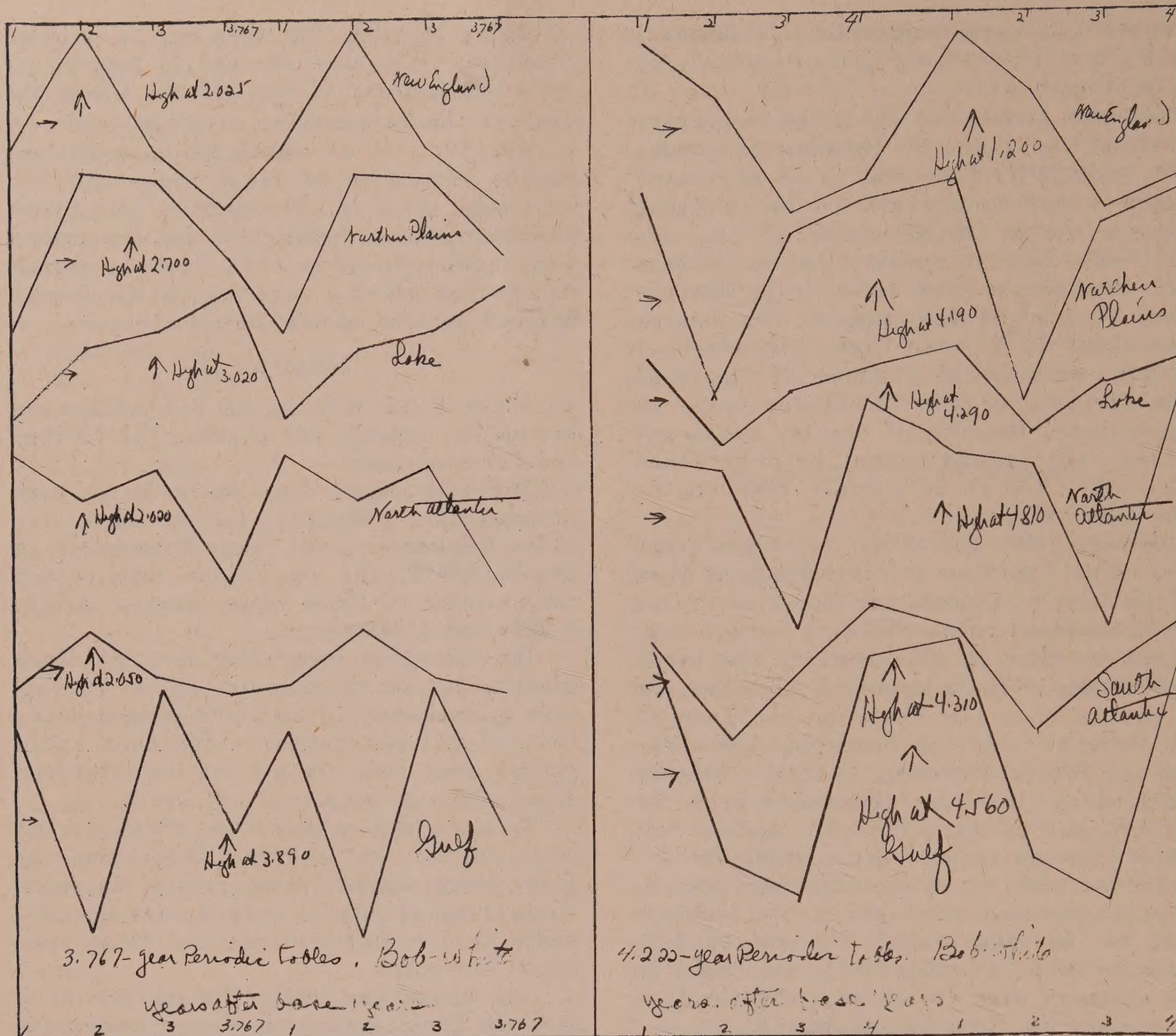

Figure 1. Graphs of periodic table of the 3.767-year length to locate times of high in the regional data of the Bob-white. The position of the high in the periodic table added to the most recent base year gives a mathematical interpretation of the current time of ideal high. Horizontal arrows mark the axis of the curve; vertical arrows mark the point of high midway between the crossing points of the curve on its own axis.

Figure 2. Graphs of periodic tables of the 4.222-year length to locate times of high in the regional data of the Bob-white.

Note: Many of the tables and figures have been reproduced from the original work sheets.

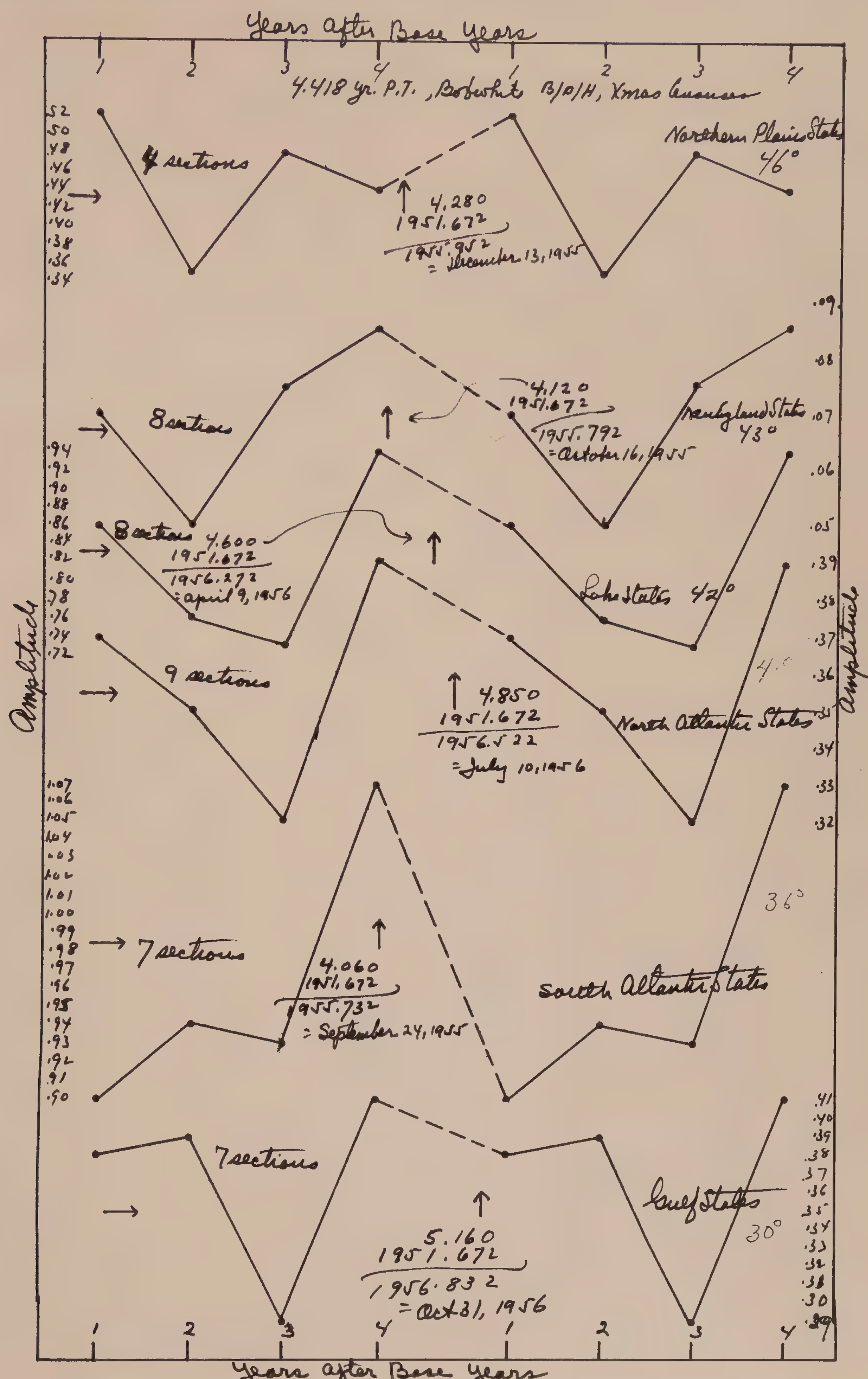

Figure 3. Graphs of periodic tables of the 4.418-year length to locate times of high in the regional data of the Bob-white.

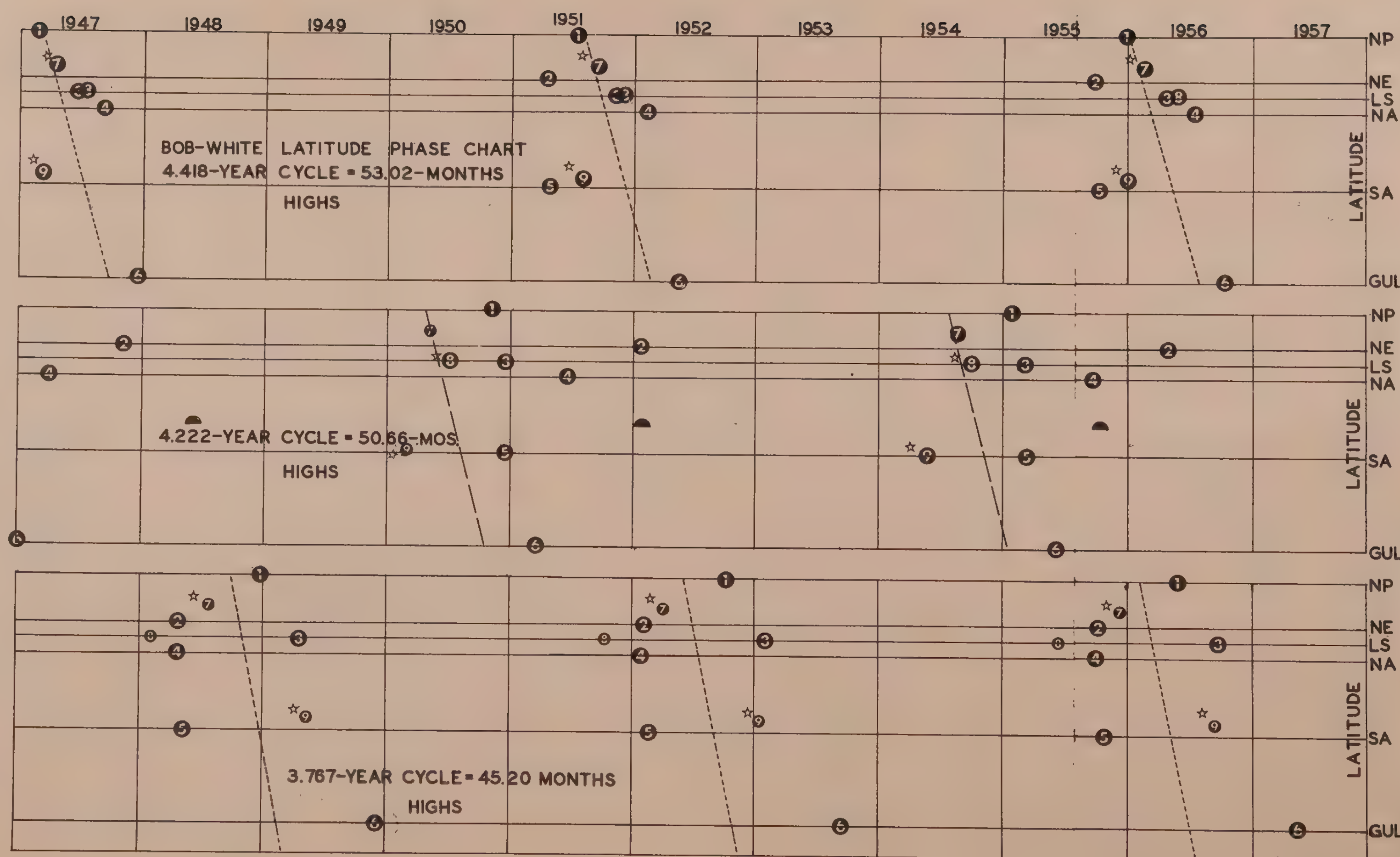

Figure 4. Latitudinal phase charts of the regionally summed data of the Bob-white in eastern North America. The current times of ideal high mark a well defined rhythm for each cycle length. The half-circle symbols in the 4.222-year chart (middle figure) mark the position of the 3.767-high of tree rings in British Columbia (about 56°N.) and are a part of the lower figure. The dashed line of the middle figure marks the slippage of the 4.222-year low of temperature. Symbols are as in Table 4.

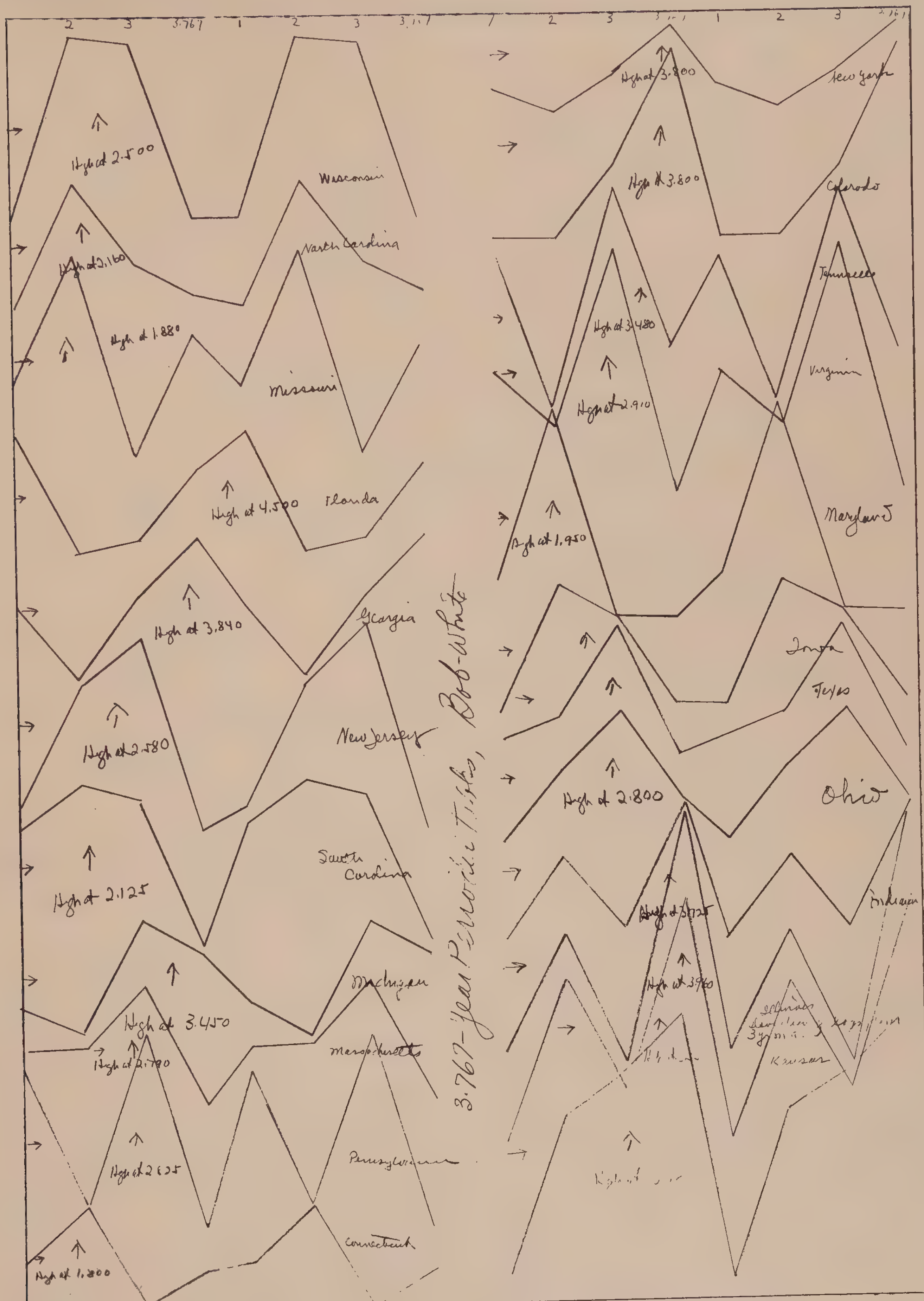

Figure 5. Graphs of periodic tables of the 3.767-year length to locate times of high of the Bob-white state data.

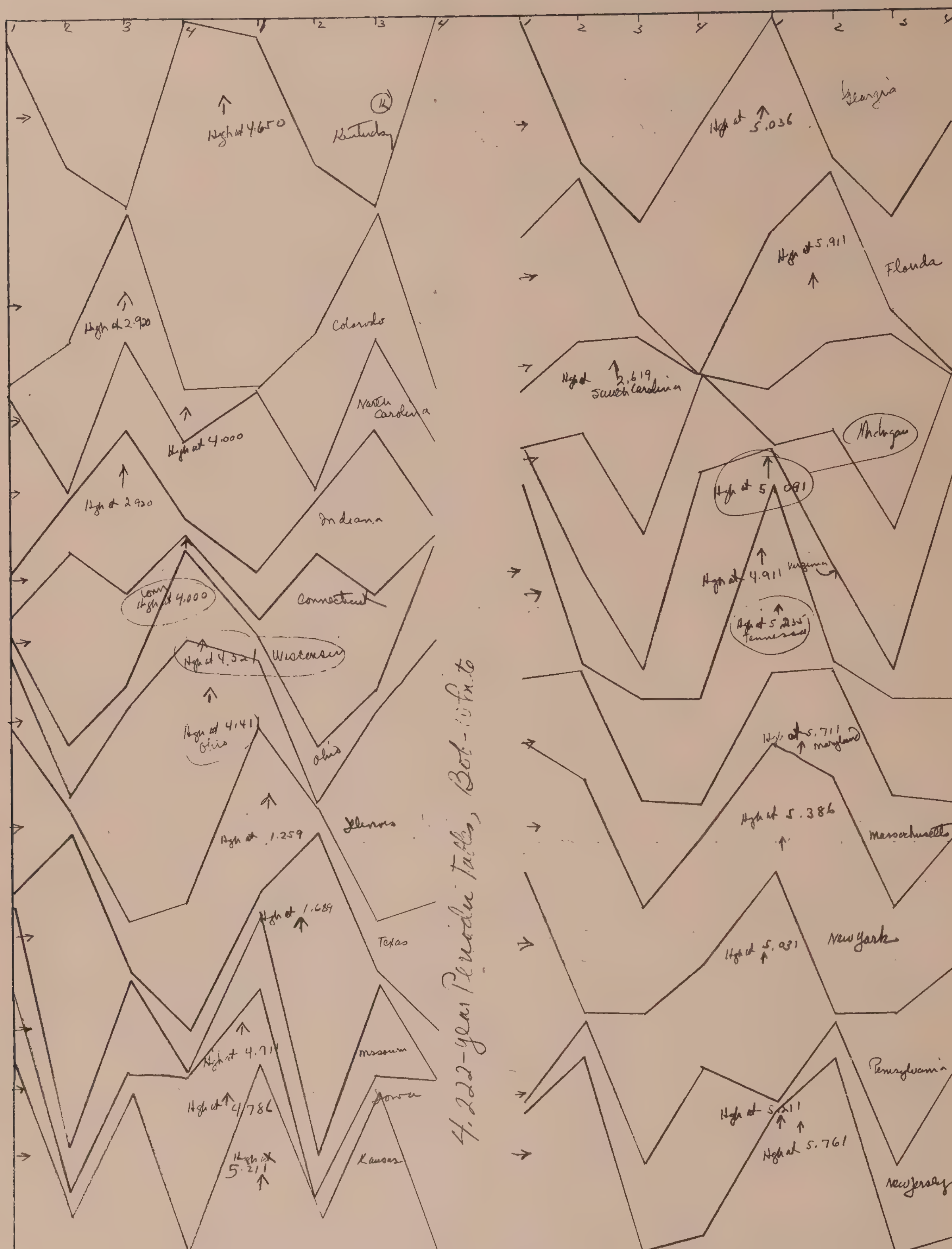

Figure 6. Graphs of periodic tables of the 4.222-year length to locate times of high of the Bob-white state data.

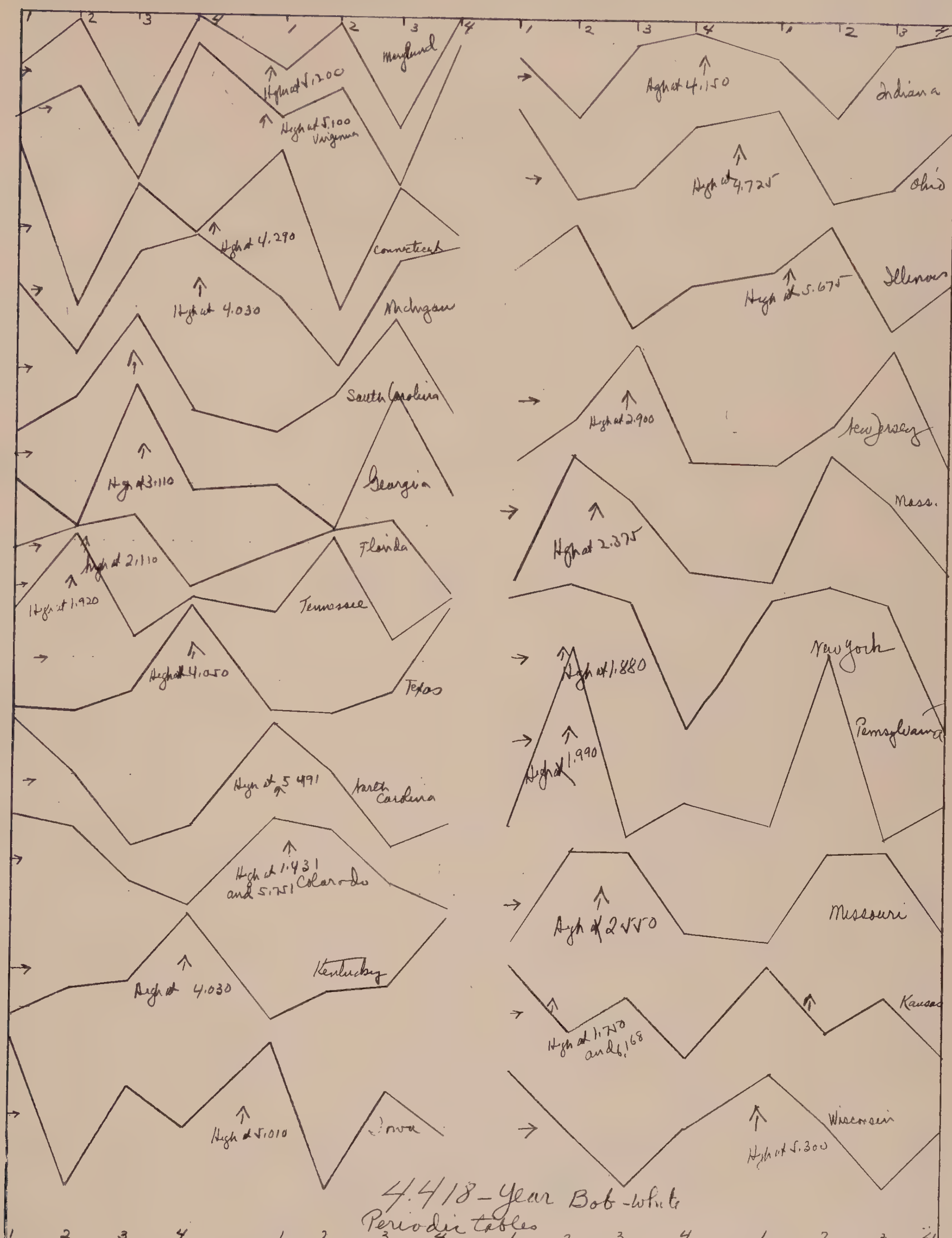

Figure 7. Graphs of periodic tables of the 4.418-year length to locate times of high of the Bob-white state data.

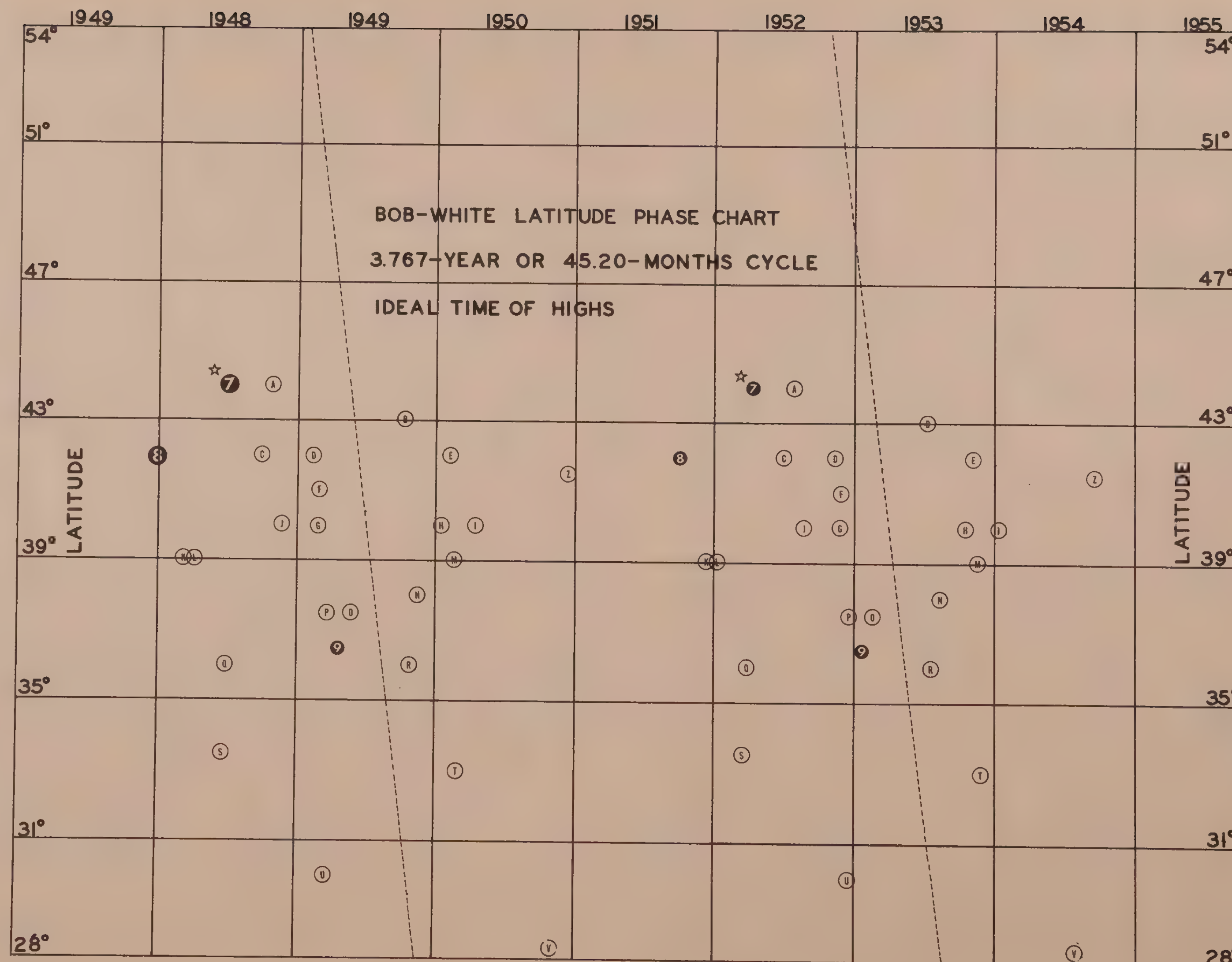

Figure 8. A latitudinal phase chart of the 3.767-year cycle for the Bob-white shows that the current times of ideal high fall in a band covering thirty-four of the possible forty-five months. The majority fall in a twelve month band. The dashed line marks the possible latitudinal slippage. Symbols are as listed in Table 8.

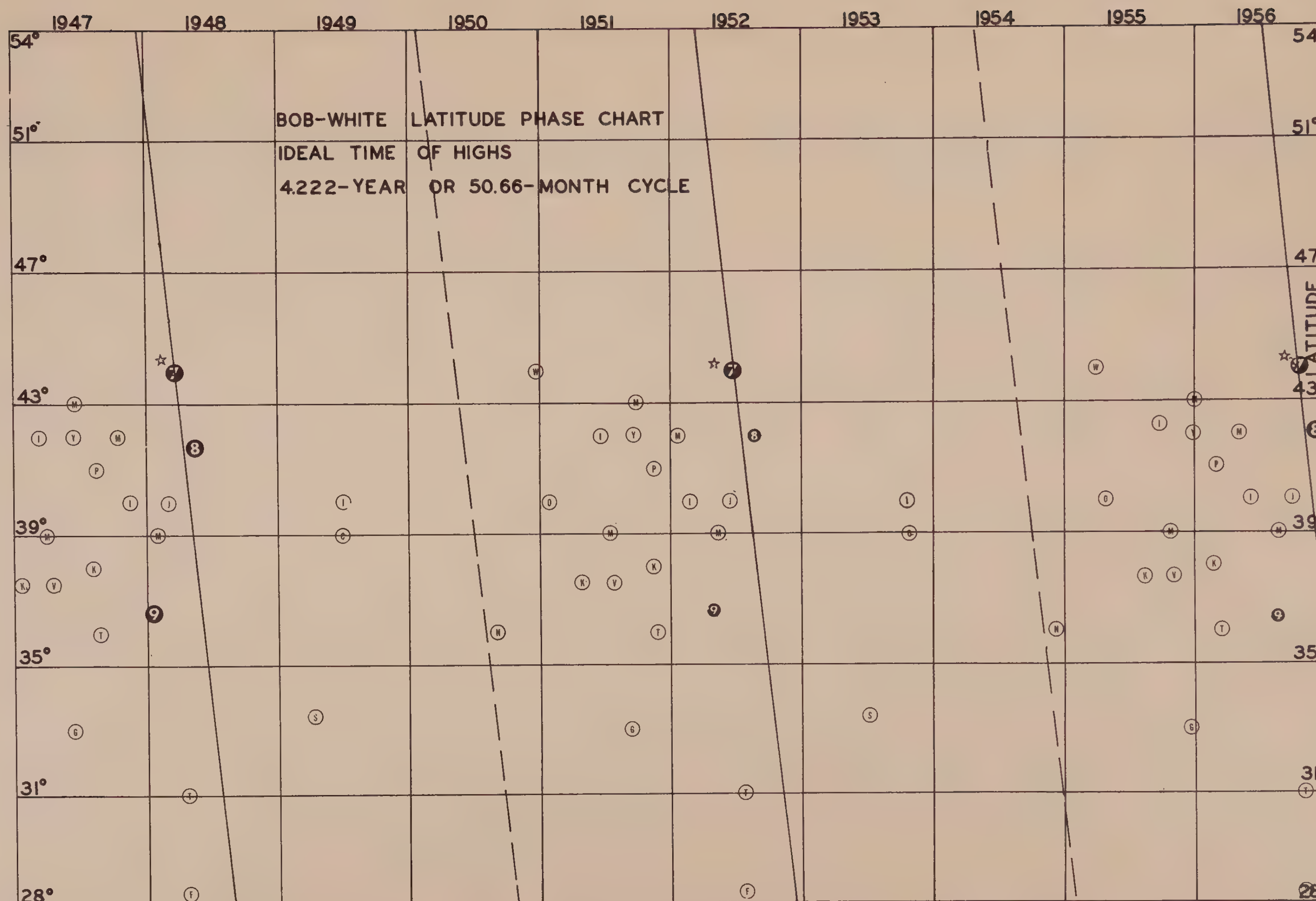

Figure 9. A latitudinal phase chart of the 4.222-year cycle for the Bob-white shows that the current times of ideal high fall in a band covering but thirty-two of the possible fifty-one months. A majority fall within an eight months band. The solid slanting line marks the passage of the temperature high and the dashed slanting line the low. Symbols are as listed Table 8.

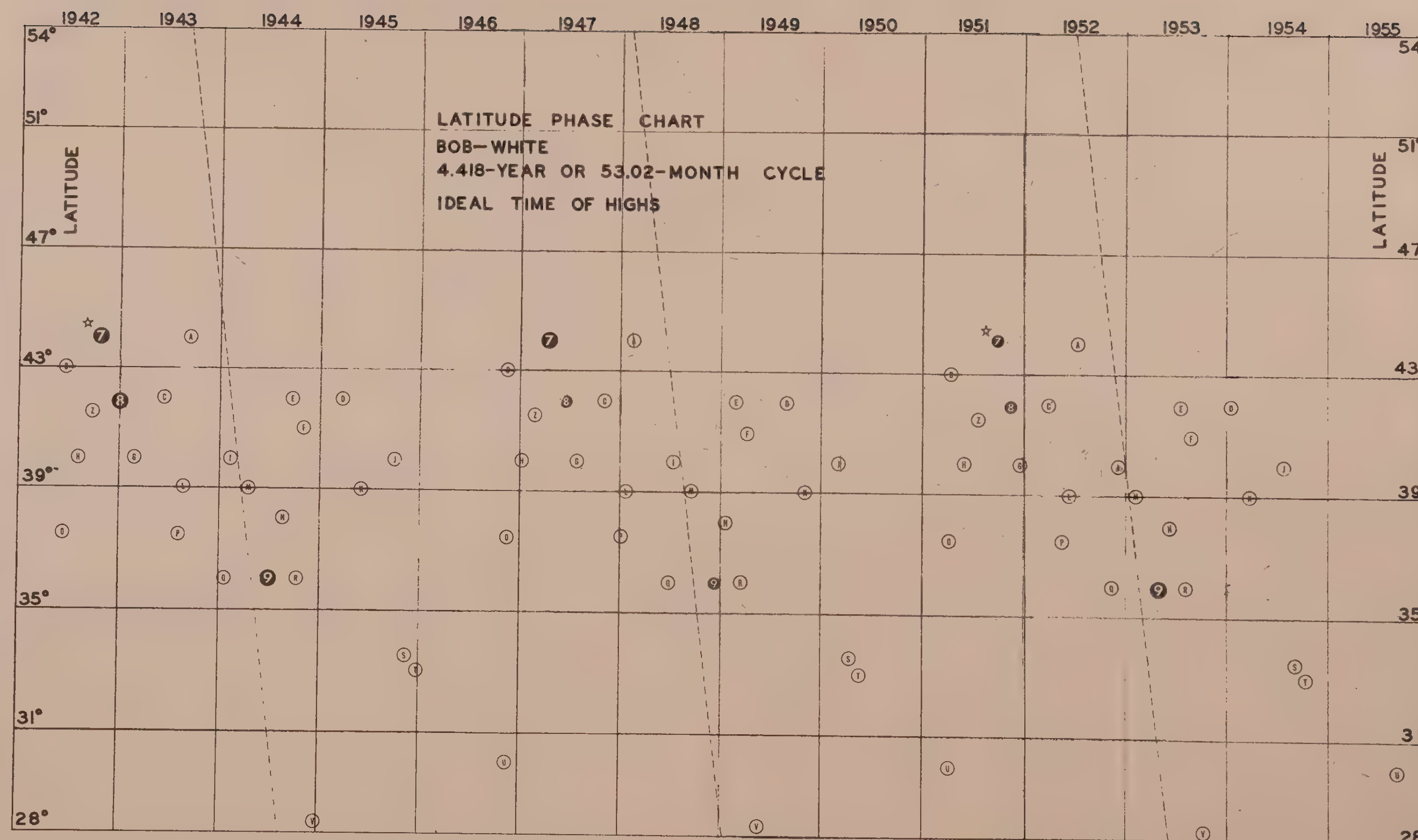

Figure 10. A latitudinal phase chart of the 4.418-year cycle for the Bob-white shows that the current times of ideal high fall in a band covering forty of the possible fifty-three months of the 4.418-year cycle. The majority fall within a seventeen months band. The dashed line marks the possible latitudinal slippage. Symbols are as listed in Table 8.

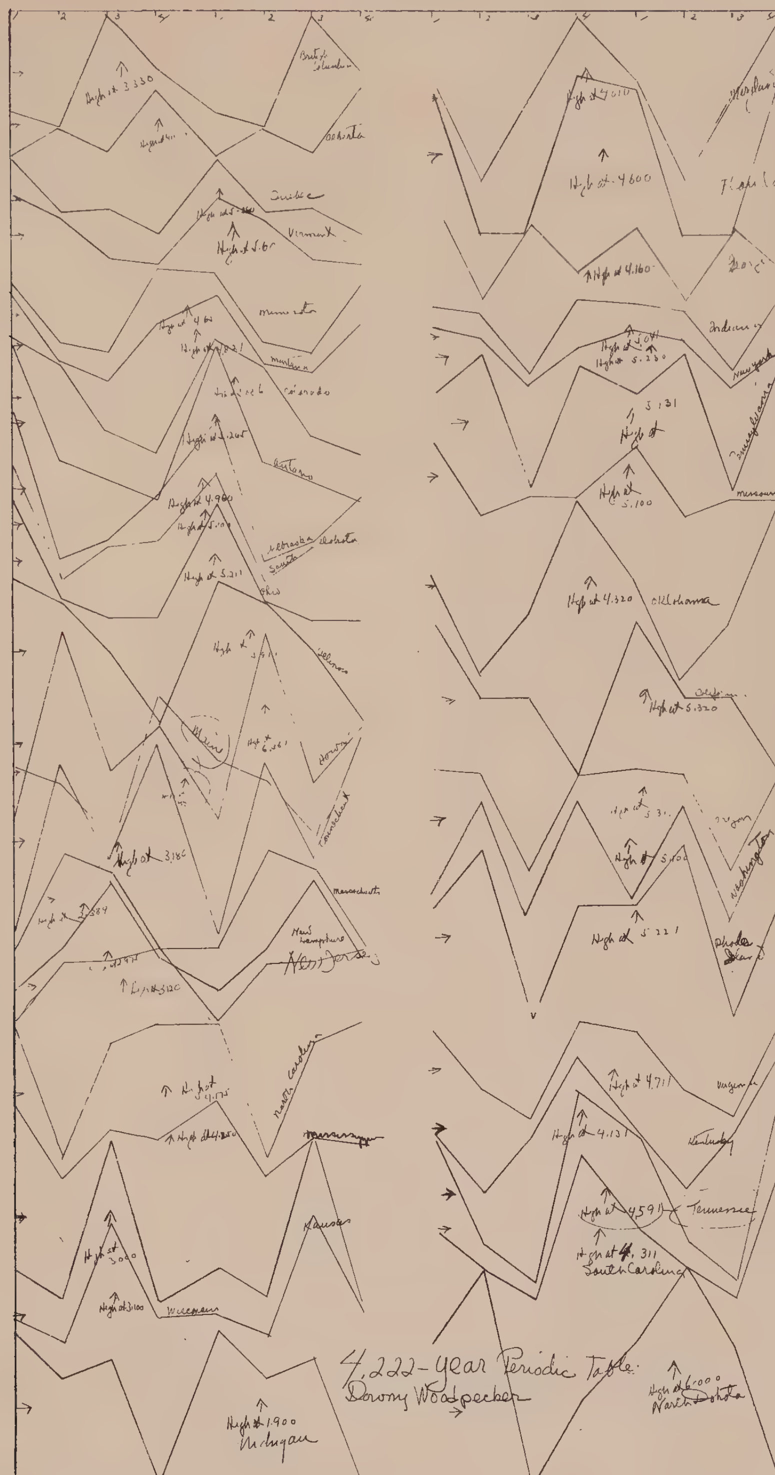

Figure 11. Graphs of periodic tables of the 4.222-year length to locate times of high of the Downy Woodpecker state data.

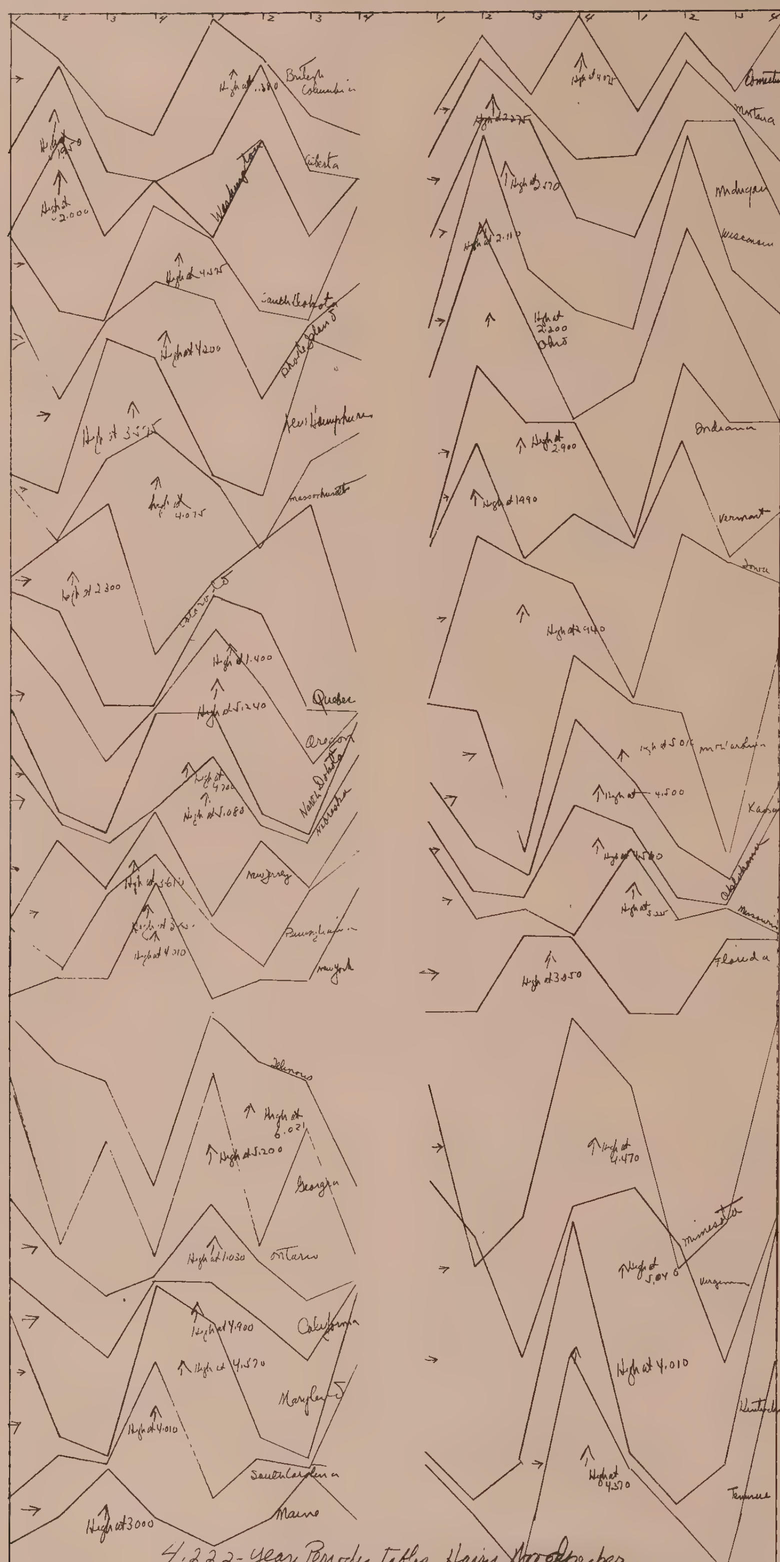

Figure 12. Graphs of periodic tables of the 4.222-year length to locate times of high of the Downy Woodpecker state data.

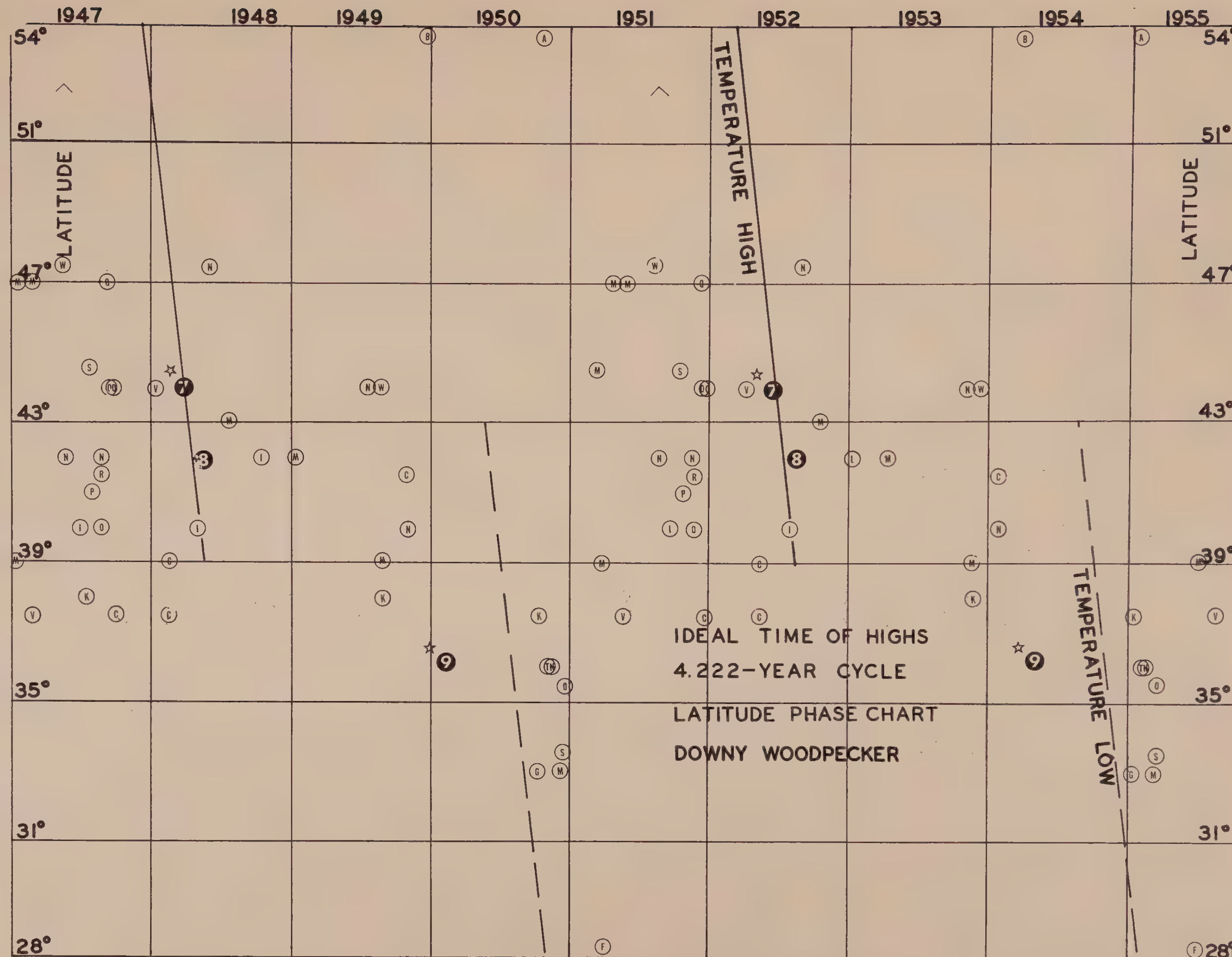

Figure 13. Latitudinal phase chart of the 4.222-year cycle in the Downy Woodpecker. The current times of ideal high cluster near the slippage line of temperature low in the more southerly latitudes and near the temperature highs farther north. Between about 38°N. and 44°N., the Downy Woodpecker highs cross over from concentration at the temperature lows to concentration at the temperature highs. The arrows mark the high of the 4.222-year cycle in British Columbia tree rings but 4° south of its actual position, which would be off the top of the chart. Symbols are as in Table 11.

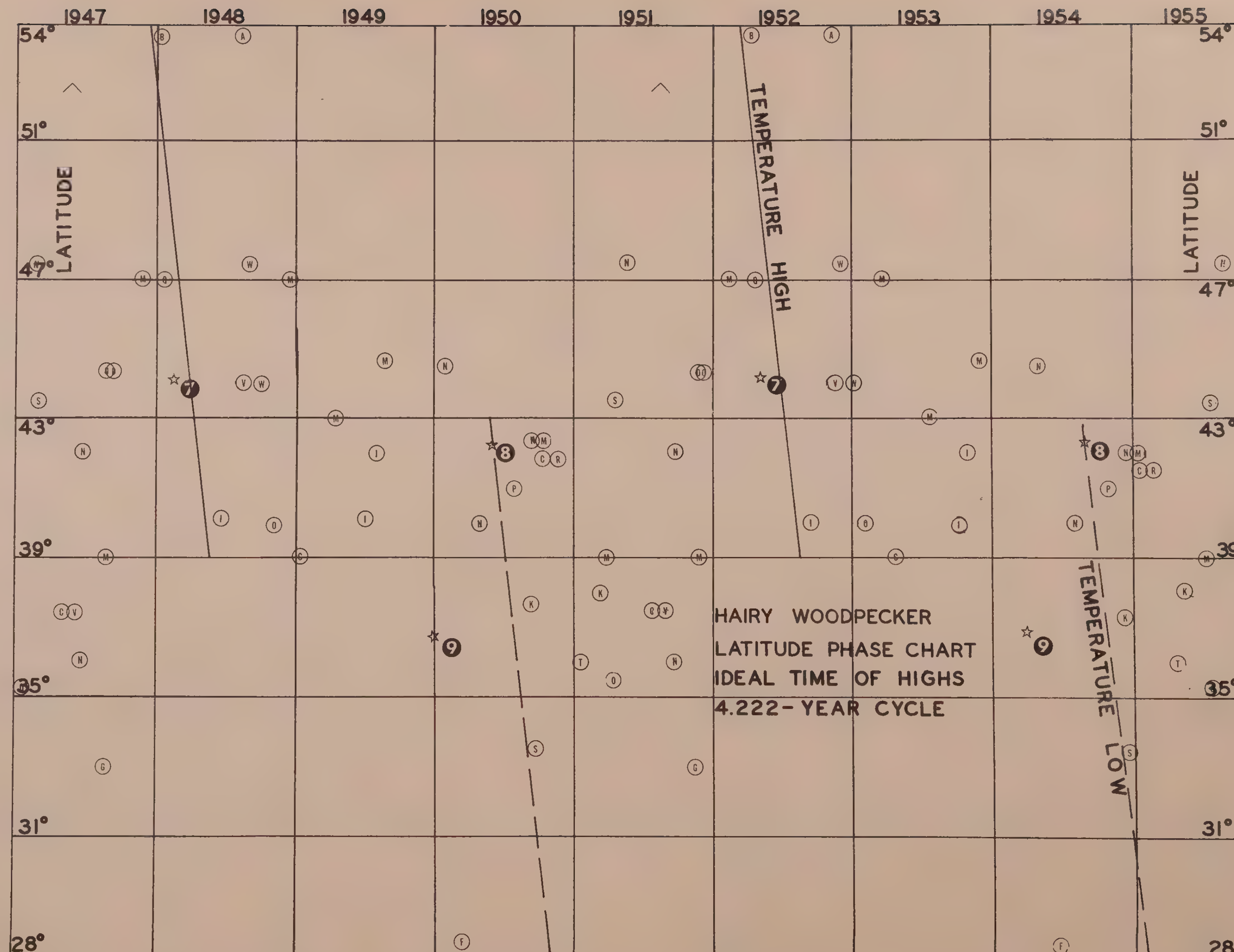

Figure 14. Latitudinal phase chart of the 4.222-year cycle in the Hairy Woodpecker. The current times of ideal high cluster near the slippage line of the temperature low in the more southerly states and the temperature high in more northerly ones. Between 39°N. and 45°N., the Hairy Woodpecker highs cross over from concentration at the temperature lows to concentration at the temperature highs. The pattern is the same as for the Downy Woodpecker (Figure 13). The symbols are as in Table 11.

TABLE 1. 3.767-year Periodic Table
Bob-white, Birds per hour
Christmas Censuses

(Whole sections only)

Base	Years after base 1	2	3	3.767	Years after base 1	2	3	3.767
	New England 43° N				Gulf States 30° N			
1901	.29	06	.28	0		45	0	2.00
1905	.09	.02	.02	.06	0	2.90	2.55	.54
1909	.05	.17	.03	.02	0	.35	.34	.25
1912	.02	.32	.15	.25	.25	.53	.02	.19
1916	0	0	.08	.07	.37	.0	0	3.15
1920	.12	.10	.09	.07	1.81	.45	.09	0
1924	.07	.22	.05	.11	.10	.31	.77	.75
1927	.11	.13	.16	.14	.15	.47	.47	.26
1931	.11	.03	.01	.04	.52	.26	.45	.55
1935	.01	.02	.06	.04	.47	.84	.84	.59
Σ	87	1.07	.93	.80	4.87	6.56	5.46	7.98
ave	.09	.11	.09	.08	.54	.66	.55	.80
	North Atlantic 41° N				Lake States 42° N.			
1901	.03	.10	.09	.15	.70	20	.34	.62
1905	.04	.15	.20	.12	.40	.32	1.38	.90
1909	.33	.51	.05	.34	.56	.66	.68	.49
1912	.34	.52	.31	.69	.49	1.17	.44	1.22
1916	.97	.43	.73	.04	.15	.34	.64	.34
1920	.51	.51	.50	.29	.48	1.38	.84	1.45
1924	.38	.25	.59	.50	1.66	.92	.92	.94
1927	.50	.58	.22	.42	.94	1.34	.56	.50
1931	.67	.26	.72	.33	.86	.83	1.42	1.34
1935	.16	.40	.47	.24	.46	.60	.72	.68
Σ	3.95	3.72	3.88	3.12	6.70	7.66	7.94	8.48
ave	.40	.37	.39	.31	.67	.77	.79	.85
	South Atlantic 36° N				Northern Plains 46° N.			
1901								
1905								
1909	1.24	1.85	.70	.93				
1912	.93	.23•	.39	.85				
1916	1.00	.86	.87	1.25•				
1920	.92	1.56	.27•	.94	.05	.54	.45	.50
1924	2.60•	.66	1.98	.83	.14	.97	.53	.31
1927	.83	1.07	1.87•	.36•	.31	.43	.76	.26
1931	.82	1.86•	.66	1.15	.31	.83	.46	.16
1935	.64•	.41	1.07	.63	.11	.26	.74	.69
Σ ÷ 1¼ / 12	5.56	6.41	5.67	5.33	.92	3.03	2.94	1.92
ave	.92	1.07	.94	.89	.18	.61	.59	.38

TABLE 2. 4.222-year Periodic Table
Bob-white, Birds per hour
Christmas Censuses

(Whole sections only)

Base	Years after base 1	2	3	4	4.222	Years after base 1	2	3	4	4.222
	New England 41° N					North Atlantic 41° N				
1900	42	.29	06	28			.03	.10	.09	
1904	0	.09	.02	.02	.06	.15	.04	.05	.20	.12
1909	.05	.07	.03	02		.33	.51	.05	.34	
1913	.32	.15	.25	0		.52	.31	.69	.97	
1917	.0	.08	.07	.12		.43	.73	.04	.51	
1921	.10	.09	.07	.07	.22	.51	.50	.29	.38	.26
1926	.05	.1	.13	.16		.59	.50	.58	.22	
1930	.14	.11	.03	.01		.42	.69	.26	.72	
1934	.04	.01	.02	.06		.33	.16	.40	.47	
1938						.34				
Σ	1.12	1.00	.68	.74		3.52	3.47	2.46	3.90	
ave	.13	.11	.07	.08		.39	.38	.27	.43	
	South Atlantic 36° N					Gulf States 30° N.				
1900										
1904		0•	.08•	0•	1.77					
1909	1.24	1.85•	.70	.93			.35	.34	.25	
1913	.23•	.39	.85	1.00		.53	.02	.09	.57	
1917	.86	.87	1.25	.92						
1921	1.56	.27	.94	2.60•	.66	.45	.09	0	.70	.31
1926	1.98•	.83	1.07	1.87		.77	.75	.47	.47	
1930	.36	.82	1.86•	.66		.26	.52	.26	.45	
1934	1.15	.64	.41	1.07		.55	.47	.84	.84	
1938	.63					.59				
Σ	5.80	3.82	5.19	6.45		3.15	2.20	2.00	3.08	
ave	.97	.64	.86	1.08		.52	.37	.33	.51	
						Northern Plains 46° N				
1900		.71	.20	.34						
1904	.62	.40	.32	1.38	.90					
1909	.56	.66	.68	.49						
1913	1.17	.44	1.22	.15						
1917	.34	.64	.34	.48			.22	.03	.05	
1921	1.38	.84	1.45	1.66	.92	.54	.45	.50	.14	.97
1926	.92	.94	1.24	.56		.53	.31	.43	.76	
1930	.50	.86	.83	1.42		.26	.31	.83	.46	
1934	1.34	.46	.60	.72		.16	.11	.26	.74	
1938	.68					.69				
	7.51	5.95	6.88	7.20		2.18	1.40	2.05	2.15	
	.83	.66	.76	.80		.44	.28	.41	.43	

Table 3. 4.418-year Periodic Table
Bob-white, Birds-per-hour
Christmas Censuses

Whole sections only

Base	Years after Base 1	2	3	4	4.418	Years after base 1	2	3	4	4.418
1899	New England States					North Atlantic States	.02	.03	.10	
1903		0	.09	.02		.09	.15	.04	.05	
1907	.02	.06	.05	.07	.03	.20	.12	.33	.51	.05
1912	.02	.32•	.15	.25		.34	.52	.31	.69	
1916	0	0	.08	.07	.12	.97	.43	.73	.04	.51
1921	.10	.09	.07	.07		.51	.50	.29	.38	
1925	.22	.05	.11	.13	.16	.26	.59	.50	.58	.22
1930	.14	.11	.03	.01		.42	.69	.26	.72	
1934	.04	.01	.02	.06		.33	.16	.40	.47	
1938	.04				axial	.24				
Σ	.58	.64	.60	.68	.08¾	3.36	3.18	2.89	3.54	axial
ave.	.07	.08	.07½	.08½		.37	.35	.32	.39	.35½
-1¼ / -12 / ave		.32 / .05								
1899	South Atlantic States					Gulf States				
1903										
1907	.93	1.77	1.24	1.85	.70		.34	0	.35	.34
1912	1.00	.23	.39	.85		.25	.53	.02	.09•	
1916	1.56	.86	.87	1.25	.92	.37	0	0	3.15•	1.81
1921	.66	.27	.94	2.60		.45	.09	0	.70	
1925	.36	1.98	.83	1.07	1.87	.31	.77	.75	.47	.47
1930	1.15	.82	1.86	.66		.26	.52	.26	.45	
1934	.63	.64	.41	1.07		.55	.47	.84	.84	
1938					axial	.59				
Σ	6.29	6.57	6.54	7.54	.98½	2.63	2.72	1.87		axial
ave	.90	.94	.93	1.07	-1¼	.38	.39	.29	2.90 / .41	.35
	Lake States					Northern Plains States				
1899										
1903		.62	.40	.32						
1907	1.38	.90	.56	.66	.68					
1912	.49	1.17	.44	1.22						
1916	.15	.34	.64	.34	.48					
1921	1.38	.84	1.45	1.66			.45	.50	.14	
1925	.92	.92	.94	1.24	.56	.97	.53	.31	.43	.76
1930	.50	.86	.83	1.42		.26	.31	.83	.46	
1934	1.34	.46	.60	.72		.16	.11	.26	.74	
1938	.68					.69				
Σ	6.84	6.11	5.86	7.48	axial	2.68	1.40	1.90	1.77	axial
ave	.86	.76	.73	.94	.83½	.52	.35	.48	.44	.43½

TABLE 4. EPOCHS OF BOB-WHITE CYCLES, REGION GROUPS OF FIGURE 4.

Region Group	Latitude °	Symbol	3.767-year cycle	4.222-year cycle	4.418-year cycle
Northern Plains	46	1	Oct. 7, 1955	Jan. 28, 1955	Dec. 13, 1955
New England	43	2	Feb. 3, 1952	April 24, 1956	Oct. 16, 1955
Lake	42	3	Feb. 1, 1953	March 6, 1955	April 9, 1956
North Atlantic	41	4	Feb. 1, 1952	Sept. 12, 1955	July 10, 1956
South Atlantic	36	5	Feb. 12, 1952	March 13, 1955	Sept. 24, 1955
Gulf	30	6	Dec. 19, 1953	June 12, 1955	Oct. 31, 1956
Tree ring (Subject to growth and calendar year reconciliation)					
British Columbia	56	half-moon	Jan. 31, 1952		
Vermont	44	7	*April 3, 1952	*July 30, 1954	*Sept. 11, 1951
Pennsylvania	42	8	Oct. 10, 1951	*Oct. 5, 1954	Nov. 16, 1951
Arizona	36	9	*Jan. 14, 1953	*May 10, 1954	*Aug. 1, 1951

(A star * indicates a low)

TABLE 5

3.767-year Periodic table. Bob-White
Christmas Censuses. Birds per hour

Massachusetts (42°) D

Base	1	2	3	3.767
1901	.32	.28	.32	0
1905	.47	.10	.10	.32
1909	.24	.20	.14	.11
1912	.11	.56	.19	.10
1916	0	0	.34	.07
1920	.47	.09	.14	.19
1924	.01	.23	.28	0
1927	0	0	.07	0
1931	.15	.15	.04	.11
1935	.04	.12	.30	0
Σ ÷ 14	.87	.87	1.15	.90
	.14	.14	.19	.09

New York (42°) E

Base	1	2	3	3.767
1901	.08	.02	0	.45
1905	.13	.21	.59	.49
1909	.23	.01	.09	.10
1912	.10	.10	.26	0
1916	.09	.15	.03	0
1920	.07	0	.15	.12
1924	.08	.33	.27	.45
1927	.45	.13	.14	.15
1931	.19	.31	.15	.23
1935	.13	.14	.17	.05
	.76	.65	.86	.10
	.13	.11	.14	.18
	1.03	.97	1.16	1.20
	.13	.12	.14	.20

Pennsylvania (41°) F

Base	1	2	3	3.767
1901				
1905				
1909	.03	.27	.14	.22
1912	.22	.43	.10	1.15
1916	.94	.60	1.40	.14
1920	1.10	.92	1.43	.58
1924	1.19	.60	.81	.74
1927	.74	.67	.67	.83
1931	.62	.55	.57	.44
1935	.14	.09	.40	.49
Σ ÷ 6	3.76	3.12	3.99	3.00
	.63	.52	.66	.50

New Jersey (40°) J

Base	1	2	3	3.767
1909	.06	.32	.03	.07
1912	.07	.11	.31	0
1916	.07	.06	0	.01
1920	.02	0	.02	.18
1924	.09	.12	0	.01
1927	.01	T	0	.03
1931	.13	.12	.06	.20
1935	.12	.03	.10	.09
	.68	.76	.62	.579
	.085	.11	.12	.08

Iowa (42°) C

Base	1	2	3	3.767
1901				
1905				
1909				
1912				
1916				
1920	.18	2.15	.15	.67
1924	.57	1.39	1.55	1.23
1927	1.23	1.71	2.17	1.03
1931	1.17	3.30	1.37	.48
1935	.45	.20	1.57	[illegible]
Σ ÷ 14	2.19	5.25	4.51	2.24
ave	.93	1.25	1.50	.75

Ohio (40°) G

Base	1	2	3	3.767
1901	2.86	.61	[illegible]	—
1905	.29	.47	2.53	.30
1909	1.3	[illegible]	1.42	.37
1912	.31	1.35	.22	1.83
1916	[illegible]	[illegible]	[illegible]	[illegible]
1920	[illegible]	5.66	[illegible]	1.48
1924	4.72	1.83	3.26	.91
1927	.71	2.57	1.41	1.49
1931	2.42	2.23	2.68	3.26
1935	1.01	1.45	2.23	2.05
	1561	2162		
Σ ÷ 6	7.48	8.93	10.07	8.29
	1.25	1.49	1.68	1.38

Kansas (38°) N

Base	1	2	3	3.767
1920	—	.06	.2	.05
1924	A	.78	1.04	—
1927	—	.43	.25	—
1931	[illegible]	[illegible]	.35	[illegible]
1935	.5	—		—
	.74	1.51	1.02	2.02
	.25	.52	.34	.67

North Carolina 36° Q

	1	2	3	3.767
	.04	1.18	1.16	.04
	.87	.91	.32	.21
	.35	.70	.29	1.16
	1.26	2.79	1.77	1.41
	.42	.93	.59	.47

Maryland (39°) L

Base	1	2	3	3.767
1905				
1909	.99	1.97	0	0
1912	.40	1.34	0	0
1916	.36	1.42	1.50	0
1920	.26	1.24	0	0
1924	.15	0	1.73	.78
1927	.78	1.50	.30	1.11
1931	1.31	.31	2.09	.70
1935	.32	.40	.32	.56
÷ 6	2.86	6.21	2.12	2.04
	.48	1.04	.35	.34

Virginia (37°30') P

Base	1	2	3	3.767
1916	1.71	0	1.73	1.00
1920	1.01	2.57	.72	.33
1924	.71	.41	1.32	.12
1927	.12	1.44	1.84	1.40
1931	1.44	1.65	2.04	2.37
1935	1.93	.47	3.24	0
	4.87	3.97	6.93	2.85
	1.22	.99	1.73	.71

Missouri (39°) K

Base	1	2	3	3.767
1901				
1905				
1909				
1912	.22	5.12	.55	1.37
1916	[illegible]	2.1	3.64	8.32
1920	1.80	1.84	2.37	[illegible]
1924	.90	.58	.56	A
1927		.62	.33	1.20
1935	2.14	1.52	1.11	1.35
	1.14	3.36	1.65	2.55
	1.14	1.68	.82	1.28

Wisconsin (44°) A

	1	2	3	3.767
	.17	.23	.48	.51
	.51	.41	.32	—
	—	—	.53	—
	—	1.27	—	.49
	—	.41	1.23	—
	—	1.08	.97	.08
	—	1.42	4.44	2.38
		.66	.14	.28
	1.33	2.79	3.67	1.38
	.17	.47	.46	.17

South Carolina 33°30' S

Base	1	2	3	3.767
1901				
1905				
1909	1.15	1.30	1.50	0
1912	0	0	.60	.57
1916	A	2.67	1.50	2.50
1920	1.92	A	A	4.27
1924	5.22	2.00	2.88	1.79
1927	1.89	1.67	5.60	.18
1931	1.52	6.46	0	.50
1935	.19	.33	.83	.91
	6.59	7.97	6.31	3.95
	1.15	1.33	1.26	.66

Texas 30° U

Base	1	2	3	3.767
1931	.30	.55	.32	.17
1935	.57	.62	2.15	.37
	.87	1.29	2.67	.56
	.44	.64	1.34	.28

Illinois 40° I
Deviation of logs from 3 yr m.a

Base	1	2	3	3.767
1901				2.277
1905	1.890	1.823	2.010	2.281
1909	1.810	2.163	1.754	2.112
1912	2.112	2.086	1.821	2.224
1916	1.733	2.183	2.066	2.096
1920	1.418	2.455	2.059	1.672
1924	2.385	1.773	1.900	2.096
1927	2.035	2.284	1.665	1.953
1931	2.650	1.164	2.213	2.237
1935	1.850	1.998	1.416	
Σ	9.758	10.255	9.706	10.765
ave	1.952	2.051	1.941	2.153

Indiana 40° H

	1	2	3	3.767
	.55	.84	1.39	0
	0	.65	0	.60
	0	0	.85	.46
	.32	0	.29	1.36
	2.02	2.11	.09	1.21
	1.21	1.32	.49	0
	0	.45	.05	1.25
	.93	.80	.85	1.81
	1.87	1.45	.98	1.81
	.44	.72	.49	.90

Tennessee 36° R

Base	1	2	3	3.767
1901				
1905				
1909				
1912	.83	.39	.76	.86
1916	1.20	1.50	.57	A
1920	1.69	.39	.55	1.25
1924	A	.18	[illegible]	.60
1927	.60	1.05	2.12	.39
1931	.53	.50	.20	.68
1935	.40	.32	.51	.72
	3.15	2.65	4.50	2.53
	.79	.53	.90	.63

Michigan 43° B

Base	1	2	3	3.767
1909	.34	.96	1.70	.88
1912	.88	0	0	0
1916	0	.21	.05	.10
1920	.36	.90	1.61	2.93
1924	2.95	.84	.88	2.09
1927	2.09	.43	1.34	.19
1931	1.11	.44	2.13	1.29
1935	0	.56	.96	.39
	2.67	2.29	3.49	3.35
	.67	.57	.95	.84

Kentucky 37°30' O

Base	1	2	3	3.767
1924				
1927				
1931	.55	1.04	.31	1.07
1935	.32	.39	1.26	.72
	.87	1.43	1.57	1.77
	.44	.72	.78	.88

Colorado 39° M

	1	2	3	3.767
			1.07	2.50
	.79	.57	.70	.64
	.89	1.42	1.28	.87
	.70	.29		
	2.38	2.38	3.05	4.26
	.79	.79	1.02	1.42

Florida 28° V

Base	1	2	3	3.767
1901				
1905				
1909				
1912				
1916				
1920				
1924	1.35	.52	1.64	1.97
1927	1.97	.72	.46	.55
1931	1.27	.50	1.27	1.20
1935	.22	.65	.42	.32
Σ ave	4.65	2.69	2.89	4.04
	1.16	.67	.72	1.01

Georgia 33° T

Base	1	2	3	3.767
1924	.70	.42	.66	.163
1927	[illegible]	[illegible]	[illegible]	[illegible]
1931	.20	.18	.32	.22
1935	.16	[illegible]	1.23	1.58
	.94	.44	.98	1.38
	.46	.22	.49	.69

TABLE 6

4.222-year Periodic Table. Bob-White

Christmas Censuses. Birds per hour

Massachusetts 42° (M)

Base	1	2	3	4	4.222
		.32	.28	.32	
	—	.47	.10	.10	.32
	.2[illegible]	.2[illegible]	.18	.11	
	.56	.1[illegible]	.40	—	
	—	.34	.07	.47	
		.1[illegible]	.17	.01	.23
1926	.28	—	—	.07	
	—	.15	.15	.04	
	.1[illegible]	.3[illegible]	.10	.30	
	—				
Σ	1.28	1.85	.98	1.42	[illegible]
ave	.26	.23	.12	.18	

New York 42° (Y)

Base	1	2	3	4	4.222
	[illegible]	.28	.12	—	
	.45	.13	.21	.59	.49
	.23	.01	.09	.10	
	.10	.26	—	.09	
	.05	.03	—	.07	
	—	.05	.12	.08	.33
	.27	.45	.13	.14	
	.15	.19	.31	.15	
	.33	.13	.14	.17	
Σ	1.67	1.33	1.02	1.39	[illegible]
ave	.21	.15	.15	.17	

Ohio 40° (O)

Base	1	2	3	4	4.222
		2.86	.61	.40	
	0	.29	1.47	3.53	1.20
	1.30	.60	.42	.31	
	1.34	.22	1.83	.24	
	.44	1.50	.81	1.55	
	5.06	6.83	4.48	4.72	1.83
	3.24	.91	2.59	1.41	
	1.49	2.42	2.23	2.68	
	3.24	2.01	1.45	2.23	
	2.05				
Σ	18.16	11.64	15.89	17.07	
ave	2.02	1.29	1.72	2.12	

Kentucky 37°30'

	1	2	3	4	4.222
		.10	.60	2.85	.11
	2.50	.158	0	•	
	0	.55	1.04	.31	
	1.07	.32	.39	1.66	
	.72				
Σ	4.29	2.55	2.03	4.52	
ave	1.07	.64	.51	1.13	

Pennsylvania 41½° (P)

Base	1	2	3	4	4.222
1900					
		.1[illegible]	.14	.22	
	.13	.10	1.5[illegible]	.94	
		1.40	.44	1.10	
	.92	1.43	.58	1.18	.60
	.81	.74	.67	.64	
	.83	.62	.54	.57	
	.44	1.44	.04	.40	
	.19				
Σ	[illegible]	4.50	2.02	3.6[illegible]	
ave	.62	.89	.40	.73	.045

New Jersey 4[illegible]° (J)

	1	2	3	4	4.222
		.33	.05	.07	
	.11	.31	—	.07	
	.36	—	.01	.32	
	—	.06	.18	.09	.12
	—	.01	.30	—	
	.03	.13	.12	.06	
	.20	.23	.03	.10	
	.19				
Σ	.89	1.02	.39	.41	
ave	.14	.17	.06	.07	.115

Illinois 40° (I)

	1	2	3	4	4.222
		1.07	.79	1.99	4.67
	1.57	1.86	.79	1.75	
	3.79	1.01	1.96	.81	
	2.12	1.57	.74	.18	
	2.44	1.43	.56	2.11	.57
	.74	1.92	2.56	.48	
	.91	2.38	.07	.66	
	1.43	.60	.71	.85	
	1.81				
Σ	14.81	11.94	8.18	8.83	
ave	1.85	1.49	1.02	1.10	

North Carolina 36°

	1	2	3	4
	.92	.04	1.18	1.16
	.21	.87	.91	.32
	1.16	.35	.70	.29
Σ	2.29	1.26	2.79	1.77
ave	.76	.42	.93	.59

Maryland (M)

Base	1	2	3	4	4.222
1909	1	1.97	•	•	
1913	1.34	•	•	.36	
1917	1.42	1.50	•	.26	
1921	1.24	—	—	.151	0
1926	1.73	.78	1.50	.30	
1930	1.11	1.31	.31	2.9[illegible]	
1934	.70	.52	.40	.32	
1938	.56				
Σ	8.1[illegible]	5.88	2.21	4.29	
ave	1.16	1.18	.74	.72	.95

Virginia 37°30' (V)

	1	2	3	4	4.222
		1.73	1.00	1.01	
	2.57	.72	.33	.71	.41
	1.32	.12	1.44	1.84	
	1.40	1.44	1.65	2.04	
	2.39	1.90	.47	3.2[illegible]	
	.57	[illegible]			
Σ	8.51	3.89	2.91	4.89	
ave	1.70	1.30	.93	1.63	

Missouri 39° (M)

	1	2	3	4	4.222
		.16	.70	1.00	
	.88	0	2.37	.22	
	5.02	.55	1.37	1.14	
	2.01	3.64	8.32	1.80	1.84
	2.37	.90	.58	.36	
	1.20	2.14	1.52	1.11	
	1.35				
Σ	3.52	1.45	2.89	2.11	
ave	1.76	.72	1.45	1.06	

Colorado 39°

	1	2	3	4	4.222
	.57	1.07	2.50	.79	[illegible]
	.70	.89	1.52	1.28	
	.87	.70	1.29	0	
Σ	2.14	2.66	4.31	2.07	
ave	.71	.89	1.44	.69	

Tennessee 36° (T)

Base	1	2	3	4	4.222
1900					
1904					
1909					
1913					
1917					
1921					
1926		.60	1.05	2.12	
1930	.39	.53	.50	.30	
1934	.68	.40	.32	.50	
1938	.92				
Σ	1st .68	.53	.50	.50	
ave	.68	.53	.50	.50	

Iowa 42° (I)

Base	1	2	3	4	4.222
1917		.88	.12	.18	
1921	2.15	.15	.67	.57	1.39
1926	1.55	1.23	1.71	2.17	
1930	1.03	1.17	3.30	1.37	
1934	.48	.45	.20	1.59	
1938	2.23				
Σ	7.44	3.88	6.00	5.88	
ave	1.49	.78	1.20	1.18	

Wisconsin 44° (W)

	1	2	3	4	4.222
		.71	0	0	
	0	0	0	2.41	.45
	.17	.23	.48	.51	
	.41	.32	0	0	
	0	.53	0	0	
	1.27	0	.49	0	.41
	1.23	0	1.08	.97	
	.68	0	1.42	4.44	
	2.38	.65	.66	.14	
	.28				
Σ	5.82	2.44	4.13	8.47	
ave	.65	.27	.46	.94	

Georgia 33° (G)

Base	1	2	3	4
1900				
1904				
1909				
1913				
1917				
1921				
1926		1.03	.38	.08
1930	.35	.24	.08	.32
1934	.22	.16	3.52	1.23
1938	1.58			
Σ	2.15	1.43	1st .38	1.63
ave	.72	.48	.38	.54

South Carolina 33°30' (S)

	1	2	3	4
1926	2.88	1.79	1.67	5.60
1930	.18	1.54	6.46	0
1934	.50	.19	.33	.83
1938	.50	1.54	1.67	.83
	1st .50	1.54	1.67	.83

Indiana 40° (I)

	1	2	3	4	4.222
	.55	.84	1.39	0	
	.65	0	.60	0	
	0	.84	.46	.32	
	0	.29	1.36	2.02	2.11
	.09	1.21	1.32	.49	
	0	0	.45	.05	
	1.25	.93	.80	.85	
	2.54	4.11	6.38	3.73	
	.36	.59	.91	.53	

Connecticut 41°30' (Z)

	1	2	3	4	4.222
		.84	0	1.36	
	0	0	0	0	0
	0	.23	0	0	
	0	.22	.18	0	
	0	.14	0	.15	
	.21	.12	.24	.38	1.08
	.02	.66	.59	.89	
	0	0	0	0	
	0	0	0	0	
	0				
	.23	2.21	1.01	2.78	
	.03	.25	.11	.31	

Michigan 43° (M)

Base	1	2	3	4	4.222
1900					
1904					
		.05	.10	.36	
1921	.90	1.61	2.93	2.75	.84
1926	.88	2.09	.45	.34	
1930	.79	1.11	.44	2.13	
1934	1.29	0	.56	.96	
1938	.39				
Σ	1st 2.57	2.79	1.45	3.45	
ave	.86	.92	.48	1.15	

Florida 28° (F)

	1	2	3	4
		1.97	.72	.46
	.55	1.07	.50	.37
	1.20	.22	.65	.42
	.91			
Σ	2.66	3.26	1.87	1.25
ave	.89	1.09	.62	.42

Texas 30° (T)

Base	1	2	3	4
1917				
1921				
1926				
1930		.30	.53	.52
1934	.17	.57	.67	2.15
1938	.74			
Σ	1.13	.87	1.51	3.40
ave	.38	.44	.50	1.13

Kansas 38° (K)

	1	2	3	4	4.222
		.53	.48	0	.18
	.06	.21	2.05		
	1.04	0	.73	.28	
	0	.44	1.73	.05	
	1.5[illegible]	.55	0	.38	
	3.14				
	5.53	1.73	[illegible]	[illegible]	
	[illegible]	.25	1.00	[illegible]	

TABLE 7

4.418-Year Periodic Tables, Bob-White Christmas Censuses, Birds per hour

Columns: Base | Years after base 1 | 2 | 3 | 4 | 4.418

Massachusetts 42° (D)

Base	1	2	3	4	4.418
1899	–	1.25	.32	.28	
1903	.32	0	.47	.10	
1907	.20	.32	.24	.20	.14
1911	.11	.56	.19	.10	
1916	0	0	.34	.07	.47
1921	.09	.14	.19	.01	
1925	.25	.28	0	0	.07
1930	0	.15	.15	.04	
1934	.11	.04	.10	.30	
1938	0				
Σ	.96	2.74	2.00	1.10	
ave	.107	.304	.222	.122	

New York 42° (E)

Base	1	2	3	4	4.418
1899		.09	.08	.02	
1903	0	.45	.13	.21	
1907	.59	.49	.23	.01	.03
1911	.10	.10	.26	0	
1916	.09	.05	.03	0	
1921	0	.05	.12	.08	
1925	.33	.27	.45	.13	.14
1930	.15	.19	.31	.15	
1934	.33	.13	.11	.70	
Σ	1.59	1.82	1.75	.77	
ave	.199	.210	.194	.086	

Pennsylvania 41° (F)

Base	1	2	3	4	4.418
1899					
1903					
1907				.27	.14
1911	.22	.43	.10	1.15	
1916	.94	.60	1.40	.44	1.10
1921	.92	1.43	.58	1.18	
1925	.60	.81	.74	.67	.64
1930	.83	.62	.54	.57	
1934	.44	1.44	.09	.40	
1938	.19				
Σ	4.14	5.33	3.45	4.38	
ave	.591	.888	.575	.626	

New Jersey [illegible] (J)

Base	1	2	3	4	4.418
1907				.32	.03
1911	.07	.11	.31	0	
1916	.07	.06	0	.01	.02
1921	0	.02	.18	.09	
1925	.12	0	.01	.00	–
1930	.03	.13	.12	.06	
1934	.20	.23	.03	.10	
1938	.09				
Σ	.58	.55	.65	.58	
ave	.093	[illegible]	.108	.083	

Maryland (39°) L

Base	1	2	3	4	4.418
1899					
1903					
1907					
1911					
1916	.36	1.42	[illegible]	0	.26
1921	1.24	0	[illegible]	[illegible]	
1925	0	1.73	[illegible]	[illegible]	
1930	1.11	1.31	[illegible]	[illegible]	
1934	.70	.32	.40	[illegible]	
1938	[illegible]				
Σ	3.97	[illegible]	2.99	4.87	
ave	.79	.96	.60	.71	

Virginia 37°30' (P)

Base	1	2	3	4	4.418
1921		.72	.33	.71	
1925	.41	1.32	.12	1.44	.27
1930	1.40	1.44	1.65	[illegible]	
1934	2.09	1.90	.47	3.24	
1938	.57				
Σ	[illegible]		[illegible]	[illegible]	
ave	[illegible]	1.44		4.81	

Ohio 40° (G)

Base	1	2	3	4	4.418
1899					
1903	.40	0	.21	1.41	
1907	3.53	1.20	1.30	.60	.42
1912	1.31	1.34	.22	1.83	
1916	.24	.44	1.50	.81	1.55
1921	5.06	1.83	4.48	4.72	
1925	1.83	3.24	.91	2.59	1.41
1930	1.49	2.42	2.23	2.68	
1934	3.24	1.04	1.45	2.23	
1938	2.05				
Σ	18.15	11.48	15.25	17.54	
ave	2.017	1.64	1.693	1.949	

Illinois 40° (I)

Base	1	2	3	4	4.418
1903			1	4.79	
1907	1.99	4.67	1.57	1.96	.79
1912	1.75	3.79	1.01	1.96	
1916	1.81	2.12	1.57	.74	.18
1921	2.44	1.43	1.56	2.11	
1925	.51	.74	1.92	2.56	.48
1930	.91	2.38	.07	.66	
1934	1.43	.60	.71	.85	
1938	1.81				
Σ	12.71	5.13	8.42	11.63	
ave	1.59	1.96	1.060	1.45	

Missouri 39° (K)

Base	1	2	3	4	4.418
1899					
1903					
1907					.70
1912	1.03	.88		2.31	
1916	.22	5.02	.55	1.37	.14
1921	2.17	3.64	8.32	1.80	
1925	1.84	2.31	.90	1.48	.36
1930					
1934	1.20	2.14	1.52	1.11	
1938	1.35				
Σ	1.18	14.05	11.29	7.23	
ave	1.297	2.810	2.822	1.446	

Tennessee 36° (R)

Base	1	2	3	4	4.418
1907					.200
1912	.83	.39	.76	.86	
1916	1.20	1.50	.57		.169
1921	.39	.55	.25		
1925	.10	2.30	.60	1.05	.212
1930	.39	.53	.50	.30	
1934	.68	.40	.32	1.50	
1938	.92				
Σ	3.68	5.67	3.00	2.71	
ave	.613	.945	.500	.678	

South Carolina 33°30' (S)

Base	1	2	3	4	4.418
1899					
1903					
1907					
1912					
1916					
1921					
1925	2.00	2.88	1.79	1.67	.60
1930	.18	1.54	6.46		
1934	.50	.19	.33	.83	
1938					
Σ	2.68	4.61	18.58	2.50	
ave	.887	1.537	2.860	1.250	

Georgia (33°) (T)

Base	1	2	3	4	4.418
1899				1.78	
1903		4.00			
1907					.52
1912	1.00	1.38		.10	
1921	.39			.72	
1925	.12	.66	1.03	.38	
1930	.35	.24	.08	.32	
1934	.22	.16	3.52	1.33	
1938	.58				
Σ	2.15	1.06	4.63	1.93	
ave	.717	.353	1.543	.643	

Florida 28° (V)

Base	1	2	3	4	4.418
1899					
1903					
1907					
1916					
1921				1.39	
1925	.82	1.64	1.97	.72	.46
1930	.50	1.07	.50	.37	
1934	1.20	.22	.65	.42	
1938	.91				
Σ	3.48	2.93	3.12	2.90	
ave	.870	.977	1.040	.725	

Iowa (42°) (C)

Base	1	2	3	4	4.418
1899					
1903					
1907					
1912					
1916			.88	.12	
1921	2.15	.15	.67	.57	
1925	1.39	1.55	1.23	1.71	
1930	1.03	1.17	3.30	1.37	
1934	.48	.45	.2	.57	
1938	2.23				
Σ	[illegible]	[illegible]	6.28	[illegible]	
ave	1.456	.830	1.256	[illegible]	

Michigan (43°) (B)

Base	1	2	3	4	4.418
1899					
1903					
1907					
1912					
1916		.21	.05	.10	
1921	.90	1.61	2.93	2.5	
1925	.84	.88	2.09	.55	.34
1930	.79	1.11	.46	2.13	
1934	1.29	0	.56	.96	
1938	.39				
Σ	5.21	3.81	6.07	6.39	
ave	1.04	.76	1.21	1.28	

Texas (30°) (U)

Base	1	2	3	4	4.418
1930		.30	.53	.52	
1934	.17	.57	.61	2.15	
1938	.74				
Σ	.91	.87	1.20	2.67	
ave	.46	.44	.60	[illegible]	

Colorado (39°) (M)

Base	1	2	3	4	4.418
1921	.57	1.07	2.50	.79	
1925	.57	.90	.89	.52	1.28
1930	.87	.70	.29		
1934					
1938					
Σ	2.08	1.47	3.68	2.31	
ave	.69	.49	1.23	1.16	

Kansas 38° (N)

	1	2	3	4	4.418
			.53	.48	.0
	.06	.21	2.05	–	
	.78	1.04	0	.73	.28
	.0	.44	1.73	.05	
	1.55	.55		.38	
	3.17				
Σ	.51	2.24	4.31	1.64	
ave	1.114	.56[illegible]		[illegible]	

Connecticut 41°30' (Z)

	1	2	3	4	4.418
		0	.84	0	
	1.36	0	0	0	
	0	0	0	.23	0
	0	0	.22	.18	
	0	0	.14	0	.15
	.21	.12	.24	.38	
	1.08	.02	.66	.59	.89
	0	0	0	0	
	0	0	0	0	
	0				
Σ	2.65	.14	2.10	1.38	
ave	.29	.02	.23	.15	

Wisconsin (44°) (A)

	1	2	3	4	4.418
		298	[illegible]		
	2.41	.45	.17	.23	.48
	.51	.41	.32	[illegible]	
			.53	0	0
	1.27		.49	0	
	.41	1.23		1.08	.17
	.04		1.42	[illegible]	
	2.38	.65	.66	.14	
	.24				
Σ	7.36	5.72	4.30	5.89	
ave	.92	.72	.54	.74	

Indiana (40°) (H)

	1	2	3	4	4.418
		.24	.36	2.02	
	2.11	.03	1.21	1.32	.47
	–	–	.45	.05	
	1.25	.93	.80	.85	
Σ	3.36	1.31	3.82	4.24	

North Carolina (36°) (Q)

	1	2	3	4	4.418
		.92	.04	1.18	1.16
	.21	.87	.91	.32	
	1.16	.35	.70	.29	
	1.10				
Σ	2.47	2.14	1.65	1.79	
ave	.82	.71	.55	.60	

TABLE 8. EPOCHS OF BOB-WHITE CYCLES, FIGURES 5, 6, & 7

STATE	LATITUDE °	'	3.767-YEAR CYCLE ~~Symbol and~~ Time of Ideal High	4.222-YEAR CYCLE Symbol and Time of Ideal High	4.418-YEAR CYCLE Symbol and Time of Ideal High
Wisconsin	44		A July 26, 1952	W Dec. 26, 1950	A July 22, 1952
Michigan	43		B July 8, 1953	W Oct. 4, 1951	B April 7, 1951
Iowa	42		C June 19, 1952	I June 15, 1951	C April 7, 1952
Massachusetts	42		D Nov. 9, 1952	M Jan. 19, 1952	D Jan. 17, 1954
New York	42		E Nov. 3, 1953	Y Aug. 12, 1951	E July 11, 1953
Connecticut	41	30	Z Aug. 20, 1954	C Nov. 21, 1954	Z July 19, 1951
Pennsylvania	41		F Nov. 22, 1952	P Nov. 17, 1951	F Aug. 19, 1953
Ohio	40		G Nov. 20, 1952	O Jan 28, 1951	G Dec. 23, 1951
Indiana	40		H Oct. 16, 1953	I Oct. 23, 1953	H May 28, 1951
Illinois	40		I Jan. 10, 1954	I Feb. 14, 1952	I Dec. 2, 1952
New Jersey	40		J Aug. 26, 1952	J June 6, 1952	J June 27, 1954
Missouri	39		K Dec. 21, 1951	M July 30, 1951	K March 23, 1954
Maryland	39		L Jan. 7, 1952	M May 19, 1952	L June 16, 1952
Colorado	39		M Nov. 13, 1953	C Oct. 23, 1953	M Feb. 8, 1953
Kansas	38		N Aug. 14, 1953	K Nov. 17, 1951	N June 4, 1953
Kentucky	37	30	O Feb. 23, 1953	K April 25, 1951	O March 24, 1951
Virginia	37	30	P Dec. 23, 1952	V July 31, 1951	P May 10, 1952
North Carolina	36		Q March 24, 1952	N Sept. 1, 1950	Q Nov. 5, 1952
Tennessee	36		R July 19, 1953	T Nov. 26, 1951	R Aug. 5, 1953
South Carolina	33	30	S March 11, 1952	S July 5, 1953	S Aug. 19, 1953
Georgia	33		T Nov 27, 1953	G Sept. 14, 1951	T Oct. 13, 1954
Texas	30		U Dec. 19, 1952	T July 31, 1952	U Sept. 25, 1955
Florida	28		V July 26, 1954	F July 31, 1952	V Oct. 13, 1953

TREE RINGS (subject to growth and calendar year reconciliation)

Vermont	44		*7 April 3, 1952	*7 June 20, 1952	*7 Sept. 11, 1951
Pennsylvania	42		8 Oct. 10, 1951	8 Aug. 26, 1952	8 Nov. 16, 1951
Arizona	36		9 Jan. 14, 1953	9 April 1, 1952	9 July 15, 1953

(A star * indicates a low)

TABLE 11. EPOCHS OF 4.222-YEAR CYCLE: DOWNY AND HAIRY WOODPECKERS.

STATE	LATITUDE ° '	SYMBOL	DOWNY WOODPECKER Current Time of Ideal High	HAIRY WOODPECKER Current Time of Ideal High
Alberta	54	A	Oct. 16, 1950	Nov. 2, 1952
British Columbia	54	B	Dec. 30, 1949	April 8, 1952
Washington	47 30	W	Sept 7, 1951	Nov 27, 1952
North Dakota	47 30	N	Aug. 31, 1952	May 14, 1951
Quebec	47	Q	Dec. 10, 1951	April 15, 1952
Minnesota	47	M	April 25, 1951	Feb. 19, 1952
Montana	47	M	June 27, 1951	March 1, 1953
Maine	44 30	M	March 2, 1951	Nov. 20, 1953
South Dakota	44 30	S	Oct. 7, 1951	March 29, 1951
New Hampshire	44	N	Nov. 12, 1953	June 19, 1954
Vermont	44	V	April 8, 1952	Nov. 16, 1952
Ontario	44	O	Dec. 6, 1951	Dec. 1, 1951
Wisconsin	44	W	Dec. 8, 1953	Dec. 30, 1952
Oregon	44	O	Dec. 23, 1951	Nov. 27, 1951
Michigan	43	M	Oct. 15, 1952	June 16, 1953
Iowa	42	I	Jan. 10, 1953	Oct. 29, 1953
Massachusetts	42	M	April 11, 1953	Sept. 27, 1950
New York	42	N	Nov. 23, 1951	Sept. 3, 1950
Nebraska	42	N	Aug. 16, 1951	Sept. 29, 1951
Rhode Island	41 30	R	Nov. 20, 1951	Nov. 12, 1950
Connecticut	41 30	C	Jan. 25, 1954	Sept. 27, 1950
Pennsylvania	41	P	Oct. 18, 1951	July 7, 1950
New Jersey	40	N	Jan. 3, 1954	April 11, 1950
Ohio	40	O	Nov. 16, 1951	Feb. 1, 1953
Illinois	40	I	July 30, 1952	Sept. 8, 1952
Indiana	40	I	Sept. 15, 1951	Oct. 6, 1953
Maryland	39	M	Nov. 24, 1953	March 27, 1951
Missouri	39	M	March 26, 1951	Nov. 21, 1951
Colorado	39	C	May 9, 1952	March 15, 1953
Kansas	38	K	Nov. 20, 1953	March 2, 1951
California	37 30	C	Dec. 27, 1951	July 26, 1951
Virginia	37 30	V	August 7, 1955	August 21, 1951
Kentucky	37 30	K	Jan. 7, 1955	August 25, 1950
North Carolina	36	N	Nov. 3, 1950	Sept. 4, 1951
Tennessee	36	T	June 24, 1955	June 13, 1951
Oklahoma	35 30	O	Dec. 26, 1950	April 7, 1951
South Carolina	33 30	S	March 14, 1955	Sept 4, 1950
Georgia	33	G	Jan. 8, 1955	Nov. 12, 1951
Mississippi	33	M	Nov 30, 1950	
Florida	28	F	June 27, 1955	June 27, 1954
TREE RINGS (subject to growth and calendar year reconciliation)				
British Columbia	56	arrow	Oct. 15, 1952	Oct. 15, 1952
Vermont	44	7	*June 20, 1952	*June 20, 1952
Pennsylvania	42	8	August 26, 1952	*Oct. 5, 1954
Arizona	36	9	*May 10, 1954	*May 10, 1954

(A star * marks a low)

TABLE 9

4.222-year Periodic Table, Downy Woodpecker
Christmas Censuses, Birds per hour

Years after base

Base year	1	2	3	4	4.222	1	2	3	4	4.222	1	2	3	4	4.222	1	2	3	4	4.222
	Alberta			(A)		Montana 47° (M)					Wisconsin 44° (W)					Nebraska 42° (N)				
1900			5.40									.57	1.00	.14						
1904			.19		0						.55	.50	.87	.46	.76					
1909							.32	.10	.0		.37	.48	.54	.40			1.12	.29	1.71	
1913						.22	.13	.22	.13		.24	.46	.22	.99			1.36	.89	.75	
1917		1.50	.25	2.23		.33	0				.96	.32	.69	.35		2.82	1.11	1.64	.52	
1921				.35	.40						.80	.52	.54	.14	.32	1.67	1.39	.81	.87	2.02
1926	.34	.33	.29	.17			.11				.31	.31	.50	.65		.86	1.19	1.45	1.11	
1930	.08	0				.04		.05	.20		.42	.04	.58	.89		2.38	1.33	2.74	3.00	
1934	.08	.18	.31					.09	.38		.52	.56	.64	.58		1.54	1.00	.39	3.29	
1938	.33					.24					.48					1.66				
Σ	.83	2.01	1.04	2.75		.83	.56	.46	.71		4.65	3.76	5.58	4.60		7.25	6.11	5.18	7.44	
ave	.21	.50	.26	.92		.21	.14	.12	.18		.52	.42	.92	.51		1.81	1.22	1.30	1.49	
	British Columbia 8.6 59° (B)					Maine 44° 30' (M)					Oregon 44° (O)					Rhode Island 41° 30' (R)				
1900																		.11	.21	
1904						.22		0	.40	0						.32		.16	.33	
1909		.16				0	.13	0	0				.09	.62		.11	.41	.13		
1913						.57	0	0	.12				.16			.34	.69	.26	.26	
1917		.12				.12	.33	.05	.11					.26		.14	.19	.13	.23	
1921				.07	0	.17	.07	0	.09	0	.47	.33				.51	.27	.37	.33	.17
1926	.20	.10	.17	.04		.14	.11	.19	.09							.15	.10	.10	0	
1930	.17	.09		.03		.06	.13	.37	.10			.50	.01	.08		.32	.10	.26	.19	
1934	.03	.06	.50	.14		.15	.22	.07	.27		.33	.29	.04	.58		.17	.22	.15	.43	
1938	.14					.18					.41					.15				
Σ	.54	.53	.67	1.14		1.44	.99	.68	1.86		1.21	1.12	.30	1.54		2.21	1.98	1.67	1.98	
ave	.14	.11	.34	.23		.16	.14	.08	.23		.40	.38	.08	.38		.25	.28	.19	.25	
	Washington 47° 30' (W)					South Dakota 44° 30' (S) (Partial)					Michigan 43° (M)					Connecticut 41° 30' (C)				
1900																	.74	.51	.85	
1904																.37	.40	.59	.54	.71
1909												.76	.94	.63		.31	.77	.78	.50	
1913							.92	.80			4.00	1.00	1.43	.67		.72	.67	.50	.70	
1917		.03	.02	.17		1.34	1.29	1.27	.42		1.17	1.21	.83	.36		.42	.74	.31	.38	
1921	.07	.03	.08			.57	.44	.22	0	.75	.73	.38	.52	.54	.60	.80	.40	.82	.70	.47
1926	.14	.10	.09	.23		.29	.25	.74	.72		.58	.62	.60	.56		.40	.48	.46	.68	
1930	.19	.14		.03		.67	.34	.33	1.00		.20	.53	.51	.52		.41	.49	.48	.67	
1934	.04	.81	.05	.46			0	.36	.57		.67	.52	.65	.89		.75	.64	.42	.36	
1938	.13					.92					.56					.35				
Σ	.57	1.11	.48	.89		2.16	1.95	2.23	1.71		3.71	3.43	3.54	2.92		4.53	5.33	4.87	5.38	
ave	.11	.22	.12	.22		.72	.49	.56	.57		.74	.69	.71	.58		.50	.59	.54	.60	
	North Dakota 47° 30' (N)					New Hampshire 44° (N) (Partial)					Iowa 42° (I)					Pennsylvania 41° (P)				
1900																	.92	.62	.76	
1904												.64	1.15	.10	.13	.80	.68	.52	.90	
1909						.21	.13	.15	.14		.97	.26	.43	.97		1.17	1.10	.48	.75	
1913						.08	.21	.24	.17		.51	2.81	.96	1.58		.96	.98	1.08	.98	
1917			.10	.57		.07	.12	.42			.33	1.24	1.28	2.42		3.58	1.28	.88	.95	
1921	.31	.17	0	0	.21	.12	.55	.18	.17		1.59	1.85	.96	1.26	1.28	1.05	.94	.89	.75	
1926	.08	.27	.14	.20		.07	.16	.19	.25		1.23	1.29	1.01	1.21		.83	.59	.73	.50	
1930	.15	1.48				.42	.51	.35	.11		.17	1.17	1.80	.88		.56	.60	.46	.73	
1934	.80	.25		.28							1.01	1.35	1.28	1.47		.81	.59	.72	1.17	
1938	.60										1.65					.77				
Σ	1.94	2.17	.24	1.05		.99	1.68	1.53	.84		3.98	5.05	4.40	4.91		7.30	7.68	6.38	7.49	
ave	.39	.54	.08	.26		.16	.28	.26	.17		.97	1.26	1.10	1.23		.81	.85	.71	.84	
	Quebec 47° (Q)					Vermont 44° (V)					Massachusetts 42° (M)					Ohio 40° (O)				
1900						0	0	.29	.40		.15	.29	.30	.16			1.19	1.09	1.21	
1904						1.33	1.29	0	.15	.46	.11	.18	.22	.17	.10	.18	1.29	2.35	.99	1.50
1909						.17	.59	.26	.16		.17	.31	.26	.11		.84	.99	1.04	1.36	
1913						2.00	.75	.99	.83		.17	.22	.28	.14		1.48	1.60	1.38	1.02	
1917		[illegible]	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	

Σ	1.93	.86	.90	.42	
ave	.39	.17	.18	.08	
	3.48	4.03	2.65	3.32	
	.55	.45	.29	.27	
	.24	.28	.27	.23	
	1.37	1.27	1.25	1.25	

Minnesota 47° (M)

1900					
1904		.23	.34	.29	.43
1909	0	.23	.39	1.53	
1913	.50	.30	1.00	1.17	
1917	.71	.73	.50	.71	
1921	1.75	.83	.80	.85	.36
1926	.55	.57	.43	.51	
1930	.69	.52	.32	.53	
1934	.50	.63	2.25		
1938	1.35				
Σ ÷12	4.30	2.98	3.46	3.77	
ave	.72	.60	.58	.75	

Ontario 44° (O)

.23	.39	.31	.33	.21
	.24	.22	.24	
.27	.29	.30	.22	
.48	.34	.31	.19	
.61	.23	.35	.23	36
.40	.43	.36	.29	
.21	.09	.20	.17	
.34	.39	.26	.61	
.35				
2.89	2.40	2.31	2.28	
.36	.30	.29	.28	

New York 42° (N)

.47	.62	.53	.63	
.30	.25	.16	.44	.31
.42	.41	.41	.44	
.78	.72	.65	.52	
.42	.37	.31	.27	
.47	.42	.48	.46	.40
.45	.40	.41	.31	
.31	.55	.44	.44	
.60	.41	.32	.55	
.48				
4.70	4.15	3.70	4.06	
.47	.46	.41	.45	

Illinois 40° (I)

	1.40	.81	.92	
1.18	.94	.60	.99	.76
1.36	1.59	1.74	1.24	
2.00	1.54	1.67	1.43	
1.63	3.23	2.09	.92	
1.70	1.53	.32	.89	1.00
1.24	.96	.82	.80	
1.52	1.43	1.79	.71	
.80	.89	.94	1.06	
1.23				
9.86	9.39	8.37	6.82	
1.41	1.34	1.19	.97	

Indiana 40° (I)

1900					
1904		2.53	1.25	.56	.29
1909	.55	1.9	.52	.72	
1913	1.87	[illegible]	1.27	1.37	
1917	.41	[illegible]	1.00	1.50	
1921	1.43	1.43	.84	1.96	1.68
1926	1.07	1.31	1.81	1.80	
1930	1.28	.80	1.45	1.95	
1934	[illegible]	1.58	1.28	2.10	
1938	.67				
Σ	[illegible]	11.46	9.42	11.90	
ave	1.66	1.43	1.18	1.49	

Virginia 37°31' (V)

	.61	.47	1.00	
1.59	.63	.55	.57	
.25	.27	.36	.01	
.84	.54	.56	.56	.41
.72	.69	.74	.53	
.70	.50	.55	.72	
1.21	.73	.58	.80	
.38				
5.69	4.22	3.81	5.19	
.81	.60	.54	.74	

Georgia 33° (G)

	1.71	.71	3.37	
1.90	.43	.30	.26	
.18			.33	
0	0	.40	.17	.25
1.29	.31	.17	.30	
.10	.08	.13	.28	
.13	.21	.22	.36	
.66				
÷4 1.64	÷4 1.03	÷4 1.65	÷4 1.53	
.41	.26	.41	.37	

Kansas 38° (K)

	.44	.26	.17	
.17	3.00			
.25	.50			
	1.22	.32	.85	
.50	1.17	.68		.26
.52	.50	.48	.83	
1.93	2.63	.80	1.68	
.51	.73	.74	1.47	
2.91				
6.87	7.59	9.90	5.35	
1.14	1.08	1.41	1.07	

Maryland 39° (M)

1900					
1904 Partial					
1909		.52	1.00	1.12	
1913	.79	.53	1.36	2.00	
1917	.54	.33	.56	1.09	
1921					.78
1926	1.27	.62	.33	.55	
1930	.55	.92	.53	[illegible]	
1934	1.62	[illegible]	.87	[illegible]	
1938	1.38				
Σ	6.15	3.60	5.65	7.71	
ave	1.02	.60	.94	1.28	

Kentucky 37°30' (K)

Partial

	1.21	2.58	1.54	
1.45	.80	1.10	1.37	1.11
1.10	1.26	1.06	3.50	
1.60	1.20	1.61	1.32	
1.63	1.29	.57	.83	
1.22				
7.00	5.76	6.92	8.56	
1.40	1.15	1.38	1.71	

Mississippi 33° (M)

		.15	.06
			.18
		.80	0
.20	1.17		.21
0	.09	0	.08
.05	0	.02	0
.18			
÷4 .23	.09	.17	.32
.12	.04	.08	.08

California 37°30' (C)

.12	.08	.09	0	
.07	.01	.01	.01	
	0	0	0	
0	.01	.03	.02	.02
.05	.04	.03	.02	
.03	.02	.04	.02	
.02	.06	.02	.02	

Missouri 39° (M)

1900			1.16	3.43	
1904		.67	2.00	.80	1.16
1909	2.40	2.08	1.05	1.14	
1913	2.50	1.11	1.63	1.21	
1917	1.86	1.76	2.46	3.18	
1921	1.43	1.87	.84	[illegible]	.87
1926	2.62	2.19	2.93	1.60	
1930			.95	.73	
1934	1.14	.70	1.33	1.09	
1938	1.76				
Σ	13.11	10.38	14.35	14.29	
ave	1.87	1.48	1.57	1.59	

North Carolina 36° (N)

		.67	.50
.15	0		
0	.24	0	.86
0	.09	.09	.26
.80			
	.15	0	
.31	.53	.44	.40
.30	.51	.61	.33
.33	.67	.93	.16
.35			
÷4 2.24	1.52	1.81	1.49
.37	.30	.36	.37

Florida 28° (F)

Partial

.05	0	.11	.21	.20
.22	.13	.04	[illegible]	
.16	.15	.32	[illegible]	
.12	.05	[illegible]		
.02				
÷4 .28	.18	.18	.29	
.14	.09	.09	.14	

Oklahoma 35°3[illegible] (O)

	.85	.40	2.00	
1.06	.47		.86	.76
.22		.23	.40	
.53	.33	.76	.86	
1.60	.26	.70	.69	
.33				
÷4 1.92	.80	1.10	2.41	
.64	.40	.55	.80	

Colorado 39° (C)

1900					
1904					
1909	.13				
1913	.14	0	.14	.08	
1917					
1921		.16		.07	.14
1926	.08	.15	[illegible]	.10	

Tennessee 36° (T)

.09	0	.40	.26	.42
.62	.57	.43	1.40	
1.00	.57	0	.72	
.50	.62	.25	0	.50
.59	.44	.67	.83	
.44	.45	.34	.13	
.35	.26	.47	.33	
.63				
4.22	2.91	2.56	4.07	
.50	.42	.37	.56	

South Carolina 33°30' (S)

Partial

	.51	.25	.38
.31	.43	.58	[illegible]
.36	.37	.31	.24
1.60	1.46	1.32	1.90
.40	.36	.33	.48

TABLE 10

4.222-year Periodic Table Hairy Woodpecker

~~Christmas Census~~, Bird per Hour

Years after base

Base Year	1	2	3	4	4.222
Washington 47°30'' (W)					
1900					
1904					
1909					
1913					
1917		.06	.02	.13	
1921	110	.06	.12	.08	
1926	.03	.10	.01	.23	
1930	.05	.07	.04	.01	
1934	.16	.30	.17	.03	
1938	.03				
Σ	.37	.59	.36	.48	
ave	.07	.12	.07	.10	
British Columbia 54° (B)					
1900					
1904					
1909					
1913					
1917					
1921			.16	.15	.29
1926	.45	.20	.19	.17	
1930	.04	.21	.15	.06	
1934	.03	.14	.10	.20	
1938	.29				
Σ	.81	.55	.60	.58	
ave	.20	.18	.15	.14	
Alberta 54° (A)					
1900					
1904		.25	.19		
1909	.40				
1913					
1917		.25	.21	.17	
1921				.09	.20
1926	.28	.67	.14	.33	
1930	.17				
1934	.08	.12	.31		
1934					
Σ	.93	1.29	.85	.59	
ave	.23	.32	.21	.20	
Quebec 47° (Q)					
1900					
1904					
1909					
1913					
1917					
1921		.22			
1926		.18	.16		
1930	.04				
1934	.08	.02	.08	.08	
1938	.20				
Σ	.32	.42	.24	.08	
ave	.11	.10	.08	.08	
Minnesota 47° (M)					
1900					
1904					
1909		.07•	.26•	.94•	
1913	.67	.40	.17•	.83•	

Base Year	1	2	3	4	4.222
Montana 47° (M)					
1926		.11	.47	.19	
1930	.14	.87	.11	.20	
1934	.11	.12	.24	.09	
1938	.26				
Σ	.51	1.10	.82	.48	
ave	.17	.37	.27	.16	
Maine 44°30 (M)					
1917		.17	0	0	
1921	.08	0	.24	.09	.13
1926	.0	.11	.19	.0	
1930	0	0	.08	0	
1934	.0	.03	.02	[illegible]	
1938	.09				
Σ	.17	.31	.53	.28	
ave	.03	.06	.11	.06	
South Dakota 44°30' (S)					
1913		.16•	.27		
1917	.53	.57	.18•	.48•	
1921	.86	.27	44		.50
1926	.29•	.38	.84•	.92	
1930	1.330	.17	33	1.25•	
1934		.77•	21	.86	
1934	.59				
Σ	1.98	1.39	1.25	1.58	
ave	.66	.35	.31	.79	
New Hampshire 44°N (N)					
1904		.13	27•	.24•	
1909	0	.06	.15	.29•	
1913	08	.05	.15	.17	
1917	09	.06	0•	0•	
1921	.19	0•	.18	.17	
1926	0•	.05•	.19•	0•	
1930	0•	.15•	.12•	.11	
1934	.21•	.13•			
1938	52•				
Σ	.36	.30	.48	.45	
ave	.09	.08	.16	.15	
Vermont 44° (V)					
1909		.18	0	.15	
1913	0	.25	.50	0	

Base Year	1	2	3	4	4.222
Wisconsin 44° (W)					
1900		.57	.29		
1904	.09	.10	.09	.20	.12
1909	.13	.43	.24	.11	
1913	.08	.46	.13	.05	
1917	.35	.32	.32	.35	
1921	.52	.33	.38	.34	.20
1926	.31	.36	.27	.15	
1930	.13	.13	.30	.78	
1934	.57	.33	.46	.41	
1938	.31				
Σ	1.23	1.77	1.42	1.04	
ave	.25	.35	.28	.26	
Michigan 43° (M)					
1909		.32	.17	.19	
1913	.	.40	.67	.33	
1917	.50	.56	.63	.36	
1921	.29	.38	.33	.40	.26
1926	.22	.32	.14	.28	
1930	.10	.15	.10	.07	
1934	.11	.07	.21	[illegible]	
1938	.32				
Σ	1.58	2.22	2.25	1.87	
ave	.26	.32	.32	.27	
Iowa 42° (I)					
1904		.48•	.23•	.10•	.20
1909	.43	.21•	.65	.36•	
1913	.34•	.62	.67	1.26•	
1917	.17•	.59	.32•	.53	
1921	.50	.57	[illegible]	.55	5
1926	60•	.57•	[illegible]	[illegible]	
1930	.58•	.62•	.67•	.47	
1934	.41	.61	[illegible]	.69•	
1934	.38				
Σ	1.72	2.39	2.29	2.22	
ave	.43	.60	.57	.55	
Massachusetts 42° (M)					
1900		01	06	02	
1904	04	.01	.07	.01	0
1909	.03	.12	.11	.09	
1913	.04	.06	.08	.07	
1917	.15	.07	.07	.20	
1921	.10	.12	.10	.10	.16
1926	.09	.11	.18	.07	
1930	.04	.02	.04	.05	
1934	.09	.07	.14	.21	
1938	.07				
Σ	.65	.49	.69	.85	
ave	.07	.05	.08	.09	
New York 42° (N)					
1900		.12	.11	.33	
1904	.02	x	0	.02	.03
1909	.09	.08	[illegible]	.06	
1913	.13	.13	.17	[illegible]	

Base Year	1	2	3	4	4.222
Rhode Island 41°30' (R)					
1900			.11	.21•	
1904	.32	0	.16•	.08	
1909	.11	0	0•	.08	
1913	.09	0•	0	.13	
1917	0•	.06•	0	0•	
1921	.09	02	.13	07	.02
1926	0	.02	0	0	
1930	0	0	.06	.04	
1934	.09	.03	.04	.11	
1938	0				
Σ	.38	.07	.34	.51	
ave	.06	.01	.05	.07	
Connecticut 41°30' (C)					
1900			.17	17	
1904		.05•	03•	06•	.16
1909	.14	.09	.15	.22•	
1913	.19	.22	.10	.22	
1917	.32•	.14	.32•	.11	
1921	.09•	.14	.20	.22	.06
1926	.11	.17	.03	.18	
1930	.10	.24•	.17	.08	
1934	.10	.18	.07	.20	
1938	.11				
Σ	.75	.94	.89	1.17	
ave	.12	.16	.13	.17	
Pennsylvania 41° (P)					
1900		.09	.11	.04	
1904	.09	.15	.13	.11	.48
1909	.03	.10	.16	.11	
1913	.19	.15	.08	.09	
1917	.03	.13	.15	.18	
1921	.16	.09	.16	.09	.18
1926	.18	.08	.12	.10	
1930	.12	.11	.15	.22	
1934	.14	.10	.14	.29	
1934	.18				
Σ	1.12	1.00	1.20	1.23	
ave	.12	.11	.13	.14	
Ohio 40° (O)					
1900		1.03	.48	.52	
1904	.67	.29	.76	.49	.29
1909	.34	.36	.30	.28	
1913	.43	.31	.48	.30	
1917	.27	.24	.37	.25	
1921	.32	.92	.36	.40	.26
1926	.26	.30	.20	.25	
1930	.27	.23	.24	.20	
1934	.30	.20	.26	.25	
1938	.26				
Σ	3.12	3.88	3.45	2.94	
ave	.35	.43	.38	.33	
Illinois 40° (I)					
1900		.38	.57	.40	
1904	.43	.33	.36	.38	.19
1909	.54	.77	.12	.45	
1913	[illegible]	[illegible]	[illegible]	[illegible]	

1938	.47			
Σ	1.69	1.09	1.23	1.90
ave	.56	.36	.41	.63

1938	.36			
Σ	.17	.51	.14	.26
ave	.06	.17	.05	.09

1938	.08			
Σ	.75	.82	.79	1.25
ave	.08	.09	.09	.14

1938	.23			
Σ	4.71	4.24	4.05	3.02
ave	.52	.47	.45	.34

North Dakota 47°30' (N)

1900				
1904				
1909				
1913	.36	.46	.27	.40
1917	.53	.57•	.18•	.48
1921	.86	.27•	.44	0•
1926	.29•	.38	.84•	.92
1930	.67	.34	.33	1.00•
1934				
1938	.92			
Σ	2.42	1.18	1.04	1.80
ave	.60	.39	.35	.60

Ontario 44° (O)

1900					
1904		.06	.10	.17	.27
1909		.24	.22	.12	
1913	.35	.33	.08	.11	
1917	.20	.20	.13	.09	
1921	.24	.14	.12	.15	.20
1926	.22	.19	.14	.10	
1930	.12	.15	.08	.07	
1934	.13	.09	.11	.23	
1938	.20				
Σ	1.46	1.40	.98	1.04	
ave	.21	.18	.16	.17	

Nebraska 42° (N)

1900					
1904					
1909		.12•	.57	.86	
1913	0•	.27•	.67	1.00	
1917	2.35•	.89	1.27•	.39•	
1921	1.01	.77	.42•	.52•	.44
1926	.43•	.59	.91•	.59	
1930	1.23	1.00	.80	2.50•	
1934	1.38•	1.50•	.52•	2.47•	
1938	.88				
Σ	3.12	2.25	2.04	2.4	
ave	1.04	.75	.68	.82	

Indiana 40° (I)

1900					
1904			.67	1.00	
1909	.25	.38	.25	.75	
1913	.33	.50	.67	.50	
1917		1.00	.60	.57	
1921	.83	.70	.55	.38	.57
1926	.25	.67	.43	.50	
1930	.25	.75	1.00	.67	
1934	1.00	1.00	1.00	.83	
1938	.83				
Σ	3.74	5.00	.17	[illegible]	
ave	.53	.71	.65	[illegible]	

Maryland 39° (M)

1900				
1904				
1909		.07	0	.17
1913	.06	0	.08	.18•
1917	.13	R	0	.10
1921	.10			.15
1926	.18	0•	0•	.10
1930	.19•	.24•	.13•	.04•
1934	.09	.08	.09	.11
1938	.06•			
Σ	.56	.15	.17	.63
ave	.11	.05	.04	.3

Kentucky 37°30' (K)

1900					
1904					
1909		.07•			
1913	.33•		.25	1.14•	
1917	.25	.12	.49•	.62	
1921	.09	.30•	.10•	.21	.11
1926	.10		.11	.63	
1930	.20	.10	.13	.18	
1934	.23	.15	.13	.03•	
1938	.06•				
Σ	.87	.37	.62	1.64	
ave	.17	.12	.16	.41	

Florida 28° (F)

1900					.47
1904			.10		
1909		0•			
1913		.03			
1917			.13•	.10•	
1921	.05	.20•		.02•	.13
1926	.04	.06	.04	.08	
1930	.06•	.03	.06	.03	
1934	.03	.06	.03•		
1938	.02•				
Σ	.12	.18	.20	.11	
ave	.04	.04	.06	.06	

California 37°30' (C)

1900					
1904					
1909		.03			
1913	.03				
1917					
1921		.03		.01	.01
1926	.01	.01	.04	.01	
1930	.01	.04	.02	.05	
1934	.07	.09	.02	.14	
1938	.11				
Σ	.23	.20	.08	.21	
ave	.05	.04	.03	.05	

Missouri 39° (M)

1900			.09•	.86•
1904		.67•	1.33•	.29•
1909	.32•	.32	.45	.29
1913	.50	.67•	.58	.39
1917	.62•	.62	.84•	.73•
1921	.48	.29	.32	.28
1926	.62•	.39	.19•	.44
1930		0•	.29	.21•
1934	.20•	.25•	.30	.32
1938	.47			
Σ	1.45	1.62	1.94	1.72
ave	.48	.40	.39	.37

North Carolina 36° (N)

1900				
1904				.14
1909		.94	0	.17
1913	.11	0	.09	
1917	.53			
1921		0	0	
1926	.08	.15	.15	.20
1930	.06	.36	.48	.12
1934	.40	.29	.12	.14
1938	.30			
Σ	1.78	1.74	.84	1.76
ave	.30	.29	.14	.35

Oregon 44° (O)

1900					
1904					
1909					
1913	.22	0	0	.05	
1917	.03	0	0	0	
1921	0	0			.14
1926	.04				
1930		.17	0	.0	
1934	.06	.03	0	.07	
1938	.06				
Σ	.41	.20	0	.12	
ave	.07	.04	0	.03	

Virginia 37°30' (V)

1900					
1904					
1909	.11		.22	.15	
1913	.68	.07	.15		
1917	.12	.25	.07	.43	
1921	.14	.11	.23	.09	.15
1926	.37	.20	.08	.11	
1930	.42	.09	.12	.10	
1934	.14	.33	.05	.32	
1938	.08				
Σ	2.06	1.05	.92	1.20	
ave	.26	.18	.13	.20	

Colorado 39° (C)

1900					
1904					
1909					
1913			.29	.08	
1917	.12	.16	.20		
1921	.07				.09
1926	.06	.24		.03	
1930	.06	.08	.03	.10	
1934	.17	.05	.08	.06	
1938	.13				
Σ	.64	.53	.60	.27	
ave	.11	.13	.15	.07	

Tennessee 36° (T)

1900					
1904					
1909					
1913		.35	0	.40	
1917	.25	.29		.77	
1921	.14	.17	.12		.40
1926	.44	.09	.21	.27	
1930	.24	.08	.10	.25	
1934	.20	.10	.17	.11	
1938	.13				
Σ	1.40	1.08	.60	1.80	
ave	.23	.18	.12	.35	

South Carolina 33°30' (S)

1900					
1904					
1909	.06	.35	.17		
1913					
1917	.27		.58	.38	
1921			.13	.52	.19
1926	.19	.50	.50	1.00	
1930	.18	.25	.15	.06	
1934	.30	.07	.09		
1938	.17				
Σ	1.17	1.17	1.62	1.96	
ave	.20	.29	.27	.49	

Kansas 38° (K)

1900				1.04	
1904	.30			.26	.17
1909			.25		
1913	.25	.17			
1917		.27	.08	1.05	
1921	.56	.38	.30		.43
1926	.22	.50	.24	.50	
1930	[illegible]	.44	.33	.53	
1934	.13	.48	.95	.48	
1938	.31				
Σ	3.57	2.24	2.15	3.86	
ave	.51	.37	.31	.64	

Oklahoma 35°30' (O)

1900					
1904	.30			.26	
1909			.25		
1913	.25	.17			
1917		.27	.08	1.05	
1921	.56	.38	.30		.43
1926	.22	.50	.24	.50	
1930	.50	.40	.33	.53	
1934	1.13	.48	.95	.48	
1938	.61				
Σ	3.57	2.24	2.15	2.82	
ave	.51	.37	.36	.56	

Georgia 33° (G)

1900					
1904					
1909		.29	1.18	.19	
1913	.85	.17	.18	.06	
1917					
1921			.07	.17	.12
1926	.11	.10	.06	.16	
1930	.04	.11	.03	.06	
1934	.13	.21	.22	.36	
1938	.66				
Σ	1.79	.88	1.14	1.00	
ave	.36	.18	[illegible]	[illegible]	